SERVICE MANUAL

BOOK #TM5779 (GAS AND DIESEL ENGINE FORKLIFT TRUCK)
C80/100CX
P80/100CX

CHASSIS AND ENGINES

SERIAL NO. 100001A and Up

WARNING

Read and observe all warnings on this unit before operating it.
DO NOT operate this equipment unless all factory-installed guards and shields are properly secured in place.

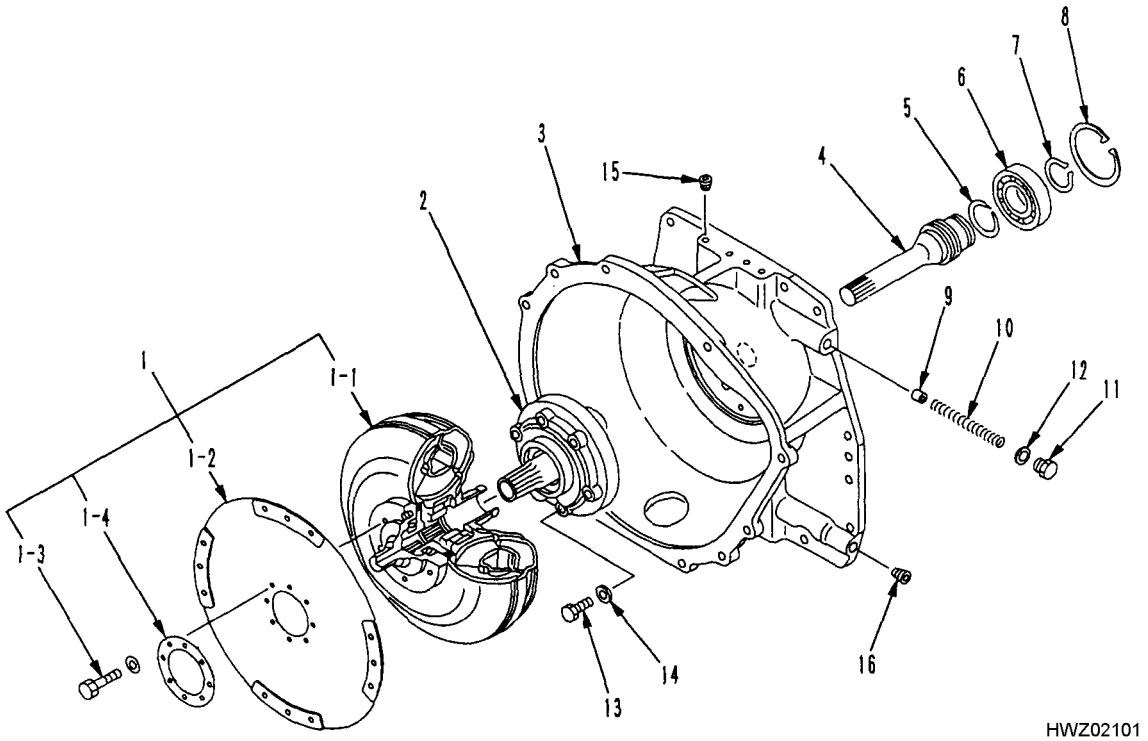
Kalmar AC

ISSUED: OCTOBER 2002
REFERENCE: SM180

30. DISASSEMBLY AND ASSEMBLY

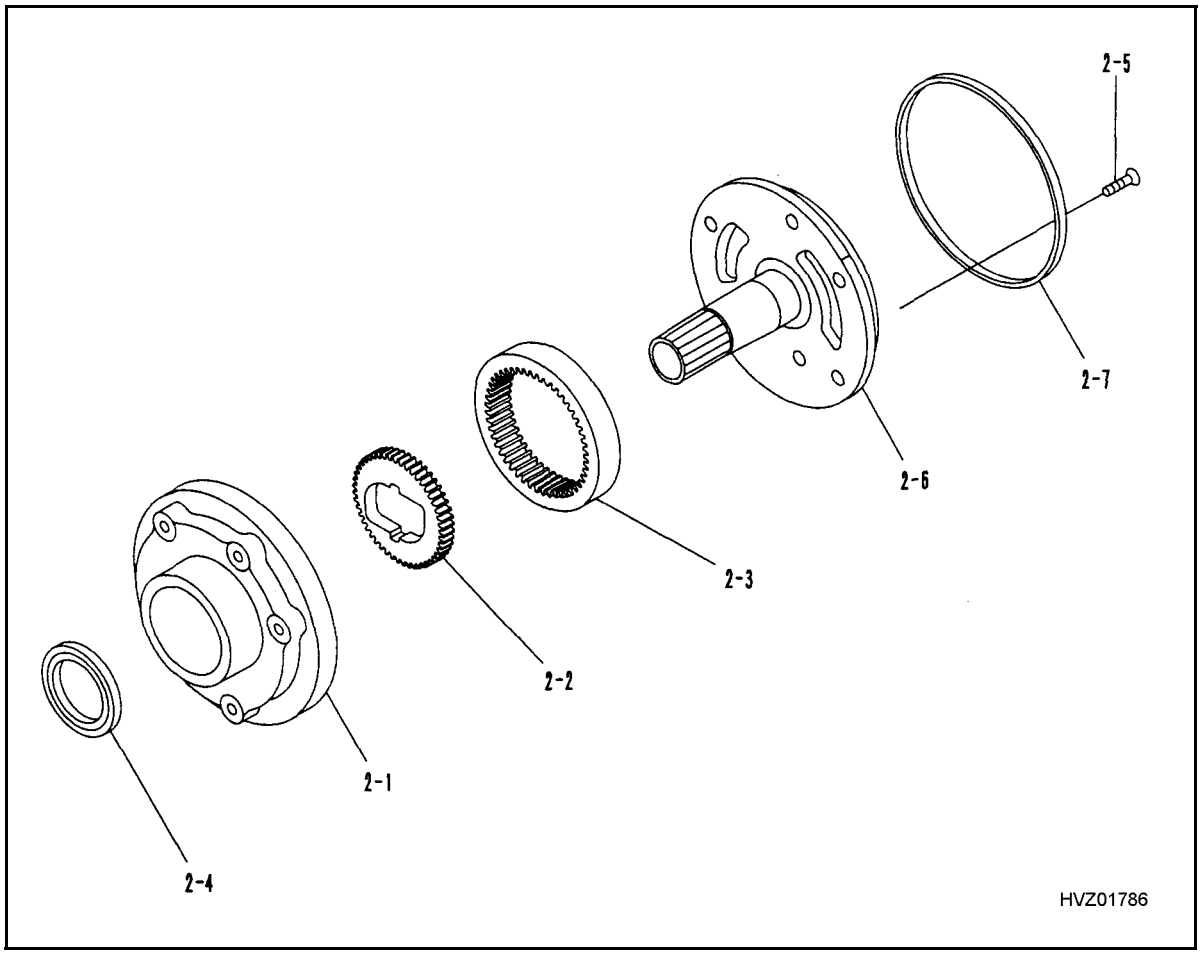
TORQUE CONVERTER (Outdoor vehicle)

COMPONENT PARTS

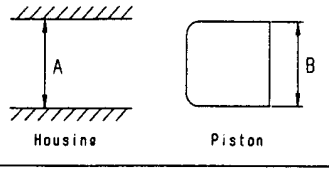
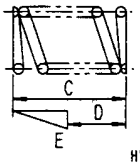
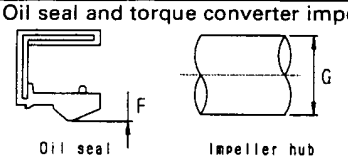
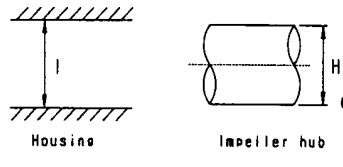
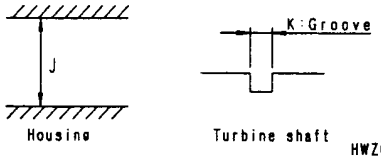
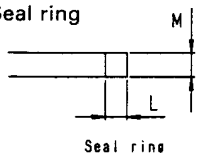


No.	Name	Q'ty	No.	Name	Q'ty
1	Torque converter circuit	1	4	Turbine shaft	1
1-2	Input plate assembly	1	5	Seal ring	1
1-3	Small hexagon bolt	6	6	Ball bearing	1
1-4	Washer	6	7	Snap ring	1
2	Gear pump assembly	1	8	Snap ring	1
2-1	Case assembly	1	9	Piston valve	2
2-2	Drive gear	1	10	Pressure spring	1
2-3	Driven gear	1	11	Plug	2
2-4	Oil seal	1	12	Gasket	2
2-5	Countersunk head screw	1	13	Hexagon bolt	5
2-6	Stator support	1	14	Gasket	5
2-7	O-ring	1	15	Hexagon socket head plug PT 1/4	4
3	Housing	1	16	Hexagon socket head plug PT 3/4	2

CASE ASSEMBLY AND STATOR SUPPORT COMPONENTS



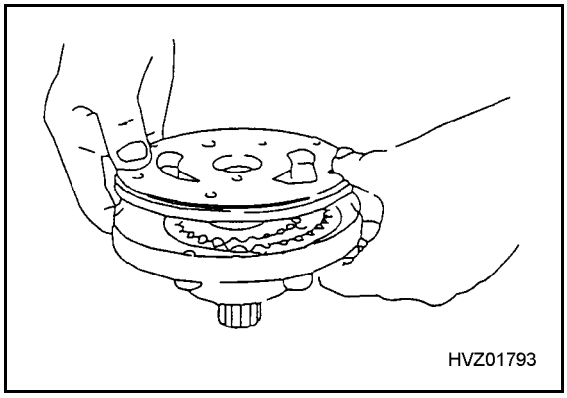
TESTING

No.	Check item	Criteria		No.	Remedy
		Standard size (mm)	Repair limit (mm)		
1	Torque converter inlet port valve Piston and housing hole 	A mm B mm Clearance mm	14 – 14.018 13.96 – 13.97 0.030 – 0.058	0.080	3 9	Replace piston
2	Torque converter inlet port valve spring 	C: Free length D: Installed length C mm E: Installed load D mm E N {kg}	103.4 62.7 75.6{7.71}±5%	68.1{6.94}	10	Replace
3	Gear pump Oil seal and torque converter impeller hub 	F mm G mm	61.915 – 61.965	61.3 61.815	2-4 1-1	
	Bushing and torque converter impeller hub 	H mm I mm Clearance mm	61.915 – 61.965 62 – 62.030 0.035 – 0.115	0.17	1-1 2-1	
4	Turbine shaft Housing hole and seal ring groove 	J mm K mm	60.00 – 60.03 2.4 – 2.5	60.15 2.6	3 4	
	Seal ring 	L mm M mm	2.5 – 2.7 2.35 – 2.40	2.3 2.15	5	

The numbers used in the No. column of the table refer to the numbers in the component part drawing.

ASSEMBLY

Carry out assembly in the reverse order of the disassembly procedures. Pay particular attention to the following items:



1) Assembly of control valve
   Insert the piston and spring correctly in their original positions, assemble in the proper sequence and install in the transmission housing.

2) Assembly of control valve
   Insert the piston and spring correctly in their original positions and assemble in the reverse order of disassembly.
   Tighten the countersunk head screw, and check that the gear rotates smoothly.
   If it does not rotate, disassemble and then reassemble again.

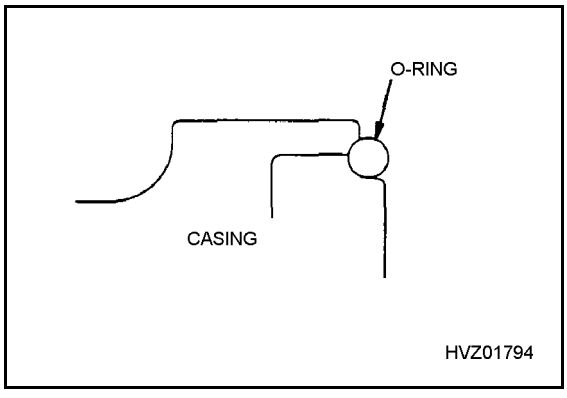
Torque countersunk head screw	0.98 Nm (0.1 kgfm) (0.72 lb-ft)

3) Assembly of inlet port relief valve
   There are two types of valves, so be sure to assemble them correctly and install in their original positions.

Torque plug	49 Nm (5.0 kgfm)(36.1 lb-ft)

4) Assembly of turbine shaft
   Check that the seal ring is securely inserted, then insert the shaft into the housing.

5) Assembly of gear pump
   Coat O-ring with thin coat of lithium grease (Shell Albania Z), and insert carefully into the pump casing.
   Greasing helps to prevent breakage or splitting of the O-ring during installation.



Coat O-ring	Lithium grease
Torque bolt	38.2 Nm (3.9 kgfm)(28.2 lb-ft)

Assemble the O-ring to the casing as shown on right

6) Assembly of torque converter
Insert the torque converter into the pump inside the housing. To avoid breakage or scratching of the oil seal and bushing during this operation, fill the area between the oil seal lip 1/3 to 1/2 uniformly with lithium grease, or coat with clean hydraulic oil.

7) Assembly of torque converter assembly
Assemble the torque converter assembly to the transmission and the engine. Replace the O-rings and oil seals with new parts.

Use care to assemble correctly. For details, see the check items in the Maintenance Standard.

When replacing a seal with a new part, coat the outside circumference with semi-dry gasket sealant (Example: Three Bond No. 1211, 1104). Be careful not to get the gasket sealant on the lip or sliding surface of the shaft.

MAINTENANCE STANDARD

1) Checking oil pressure

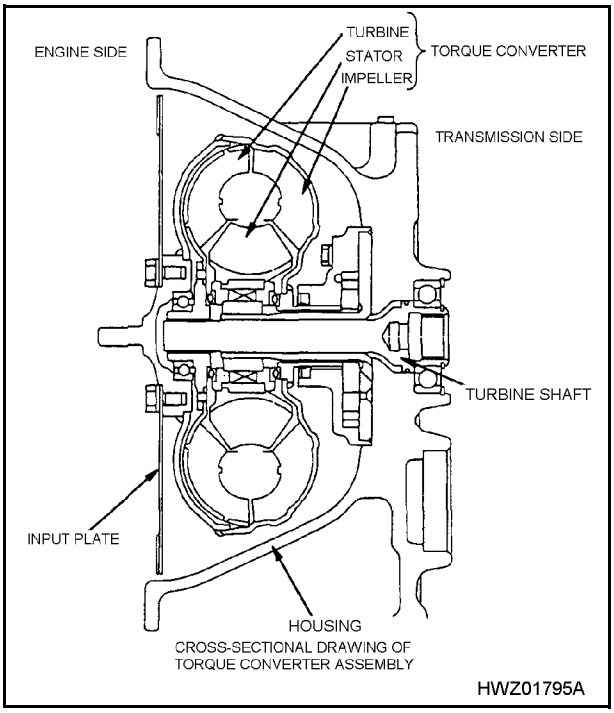
Location	No.	Check item	Pressure	Port position
Torque converter	1	Torque converter inlet port pressure	0.5 - 0.7 MPa (5 - 7 kgf/cm^2) (72.5 - 101.5 psi)	E

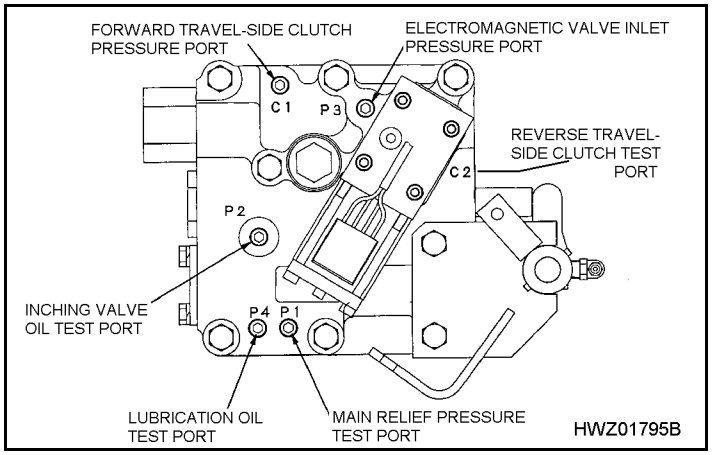
2) Tightening torque for bolts and plugs

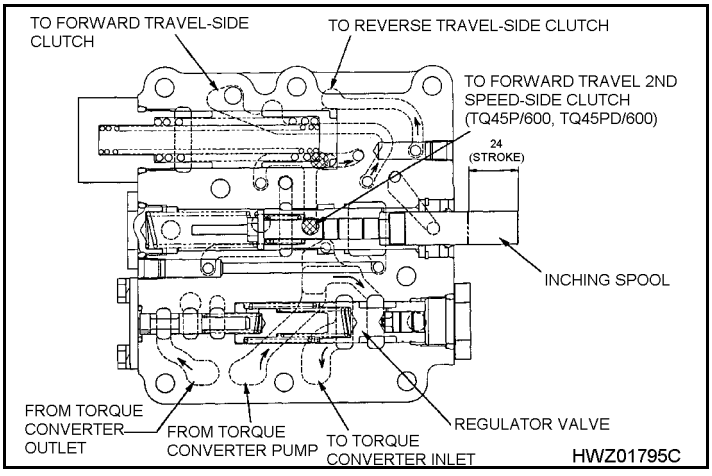
Component	No.	Tightening location	Screw specification		Tightening torque Nm (kgfm) (lb-ft)		No.
					Target	Maximum	
Torque converter	1	Input plate mount	Hexagon bolt	M10 x 1.5 x 16	57.8 (5.9) (42.6)	74.5 (7.6) (54.9)	1 - 3
	2	Gear pump ass'y	Countersunk head screw	M5 x 0.8 x 16	0.98 (0.1) (0.72)	2.94 (0.3) (2.17)	2 - 5
	3	Inlet port valve mount	Plug	M16 x 1.5 x 10	49.0 (5.0) (36.1)	63.7 (5.9) (47.0)	11
	4	Gear pump mount	Small hexagon bolt	M10 x 1.5 x 45	38.2 (3.9) (28.2)	49.0 (5.0) (36.1)	13
	5	Pressure pickup ports	Hexagon socket head plug	PT 1/4	7.35 (0.75) (5.4)	9.8 (1.0) (7.2)	15
	6	Blind plug		PT 3/4	56.8 (5.8) (41.9)	70.6 (7.2) (52.1)	16

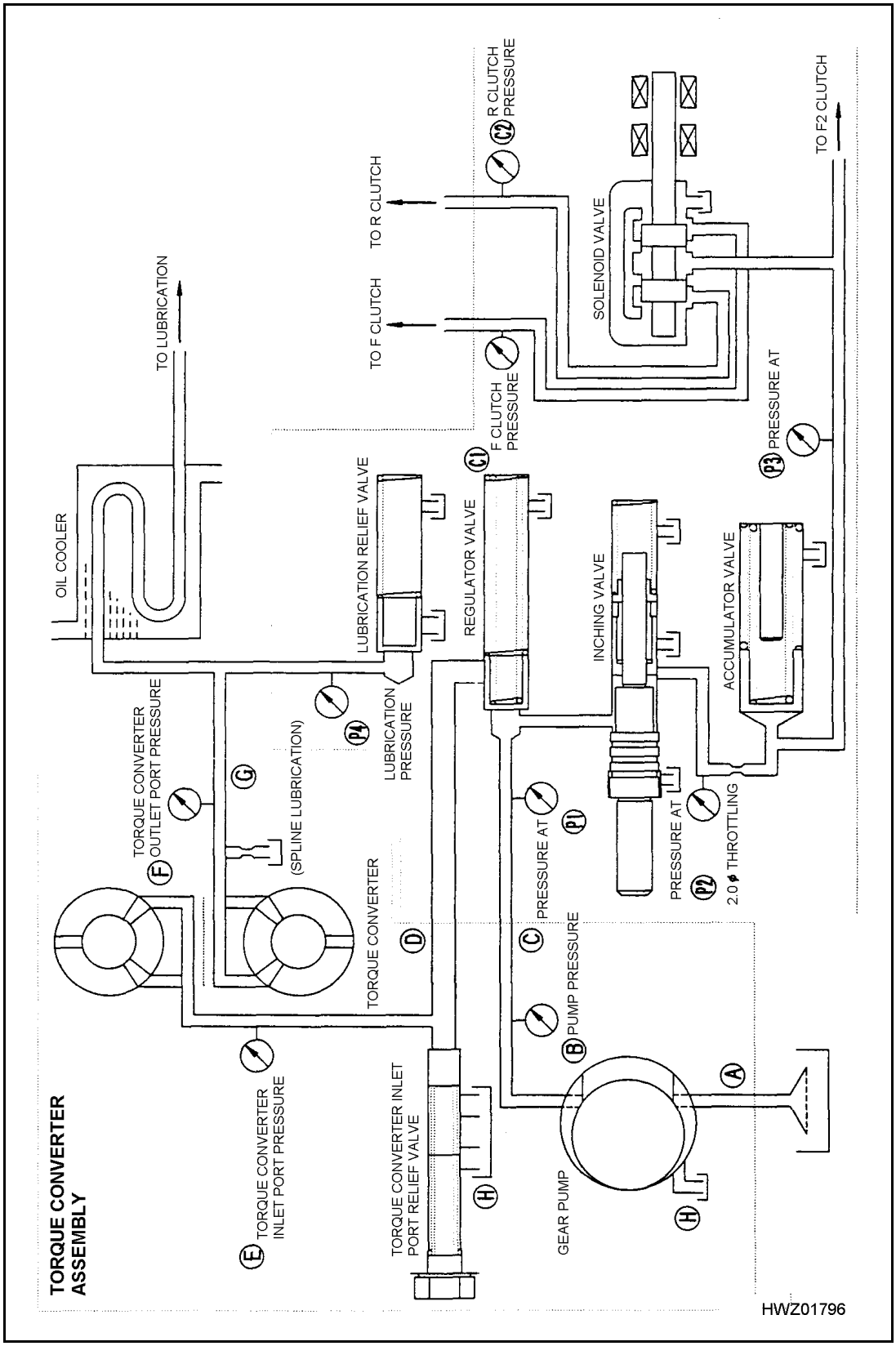
The numbers used in the No. column of Table refer to the numbers in the component part drawing.

ASSEMBLY DRAWING (OUTDOOR PNEUMATIC LIFT TRUCK ONLY)








TORQUE CONVERTER ASSEMBLY
TO LUBRICATION
OIL COOLER
TO R CLUTCH
TO F CLUTCH
R CLUTCH PRESSURE
F CLUTCH PRESSURE
SOLENOID VALVE
TO F2 CLUTCH
PRESSURE AT
LUBRICATION RELIEF VALVE
REGULATOR VALVE
INCHING VALVE
ACCUMULATOR VALVE
TORQUE CONVERTER OUTLET PORT PRESSURE
(SPLINE LUBRICATION)
LUBRICATION PRESSURE
TORQUE CONVERTER
PRESSURE AT
PRESSURE AT
2.0 THROTTLING
PUMP PRESSURE
TORQUE CONVERTER INLET PORT PRESSURE
TORQUE CONVERTER INLET PORT RELIEF VALVE
GEAR PUMP
HWZ01796

TROUBLE SHOOTING GUIDE
(CAUSES AND REMEDIES FOR FAILURES)

No.	Problem	Cause	Remedy
1	Power is not transmitted	A No hydraulic pressure	
		1) Lack of oil	Add oil
		2) Damaged gear pump or drive portion	Disassemble and check, replace with new parts or replace whole assembly
		3) Damaged piping or joint	Disassemble and replace
		4) Broken piston in inlet port relief valve or broken spring	Disassemble and replace
		B Mechanical breakage	
		1) Broken input plate	Disassemble and replace
		2) Broken shaft, gear	Disassemble and replace
		3) Broken spline	Disassemble and replace
2	Output drops	A Hydraulic pressure is too low	
		1) Lack of oil	Add oil
		2) Leakage of air from suction piping	Check joint, gasket, replace parts if necessary
		3) Drop in efficiency of gear pump	Disassemble and replace, replace parts if necessary
		4) Deteriorated spring in inlet port relief valve or defective operation of piston	Disassemble and replace, replace parts if necessary
		5) Worn or broken seal ring	Disassemble and replace
		B Mechanical breakage	
		1) Broken or deformed impeller	Disassemble and replace
		2) Deformed input plate	Disassemble and replace
		C Other	
		1) Non-specified oil is being used	Change to specified oil
3	Oil pressure rises abnormally high	1) Incorrect oil level	Add or drain oil
		2) Contact of impeller	Disassemble and replace, replace parts if necessary
		3) Wear or seizure of bearing	Disassemble and replace, replace parts if necessary
		4) Wear or damage of gear pump	Disassemble and replace, replace parts if necessary

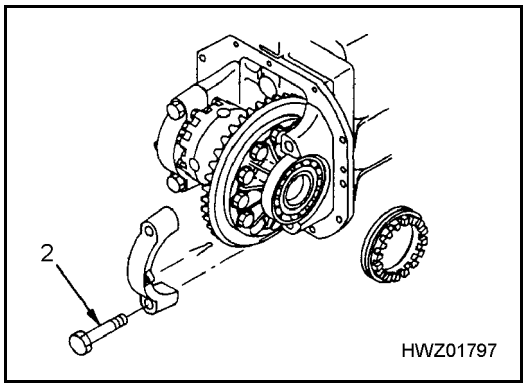
No.	Problem	Cause	Remedy
4	Abnormal noise is generated	1) Cavitation caused by leakage of air from suction piping or lack of oil	Add oil or check and replace parts if necessary
		2) Failure of gear pump	Disassemble and replace parts or whole assembly
		3) Contact caused by deformed impeller	Disassemble and replace, replace parts if necessary
		4) Breakage of input plate	Disassemble and replace
		5) Breakage of gear	Disassemble and replace
		6) Wear or breakage of bearing	Disassemble and replace
		7) Wear of spline	Disassemble and replace
		8) Loose bolts	Tighten, replace if necessary
5	Oil oozes out or leaks	A Oil seal	
		1) Worn or damaged lip	Disassemble and replace
		2) Dirt caught	Disassemble and replace, replace parts if necessary
		3) Worn or scratched shaft	Correct or replace
		4) Hardening or deterioration of rubber because of abnormal rise in oil temperature	Disassemble and replace
		B O-ring	
		1) Broken O-ring	Disassemble and replace
		2) Scratched mating surface	Correct or replace
		3) Hardening or deterioration of rubber because of abnormal rise in oil temperature	Disassemble and replace
		4) Sudden use in extremely cold temperatures (below -15°C)	Carry out warming-up operation
		C Plug, screw	
		1) Loose screw	Tighten
		2) Broken screw	Replace
		3) Cracked hole	Replace

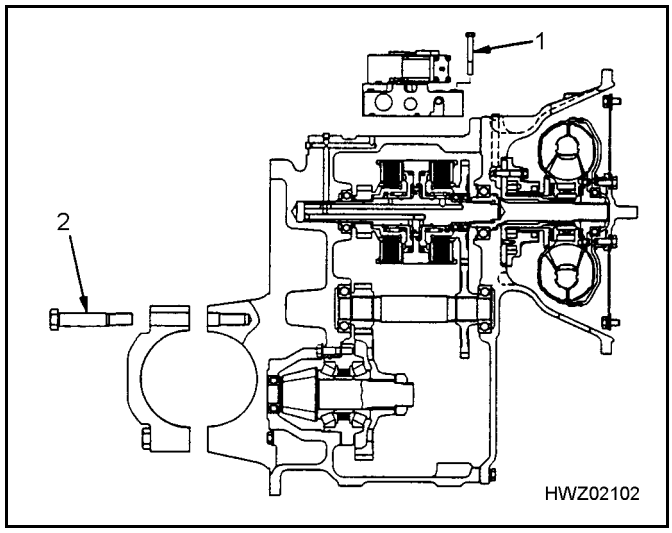
TORQFLOW TRANSMISSION (OUTDOOR LIFT TRUCK)

DISASSEMBLY

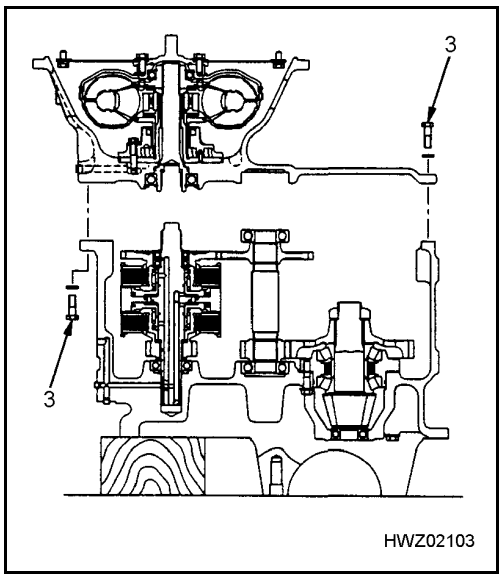
1) Draining oil
   Remove drain plug and drain oil from case

2) Transmission valve, differential
   Remove transmission valve mounting bolts (1) and differential cap bolts (2), and separate to avoid mixing the bolts.



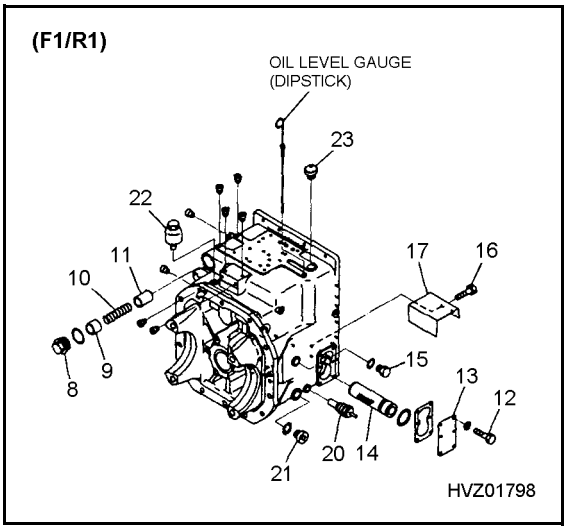


3) Torque converter
   A) Use wooden blocks for support and place equipment as shown at right
   B) Remove bolts (3) connecting torque converter and transmission case, and move the torque converter assembly away from the transmission



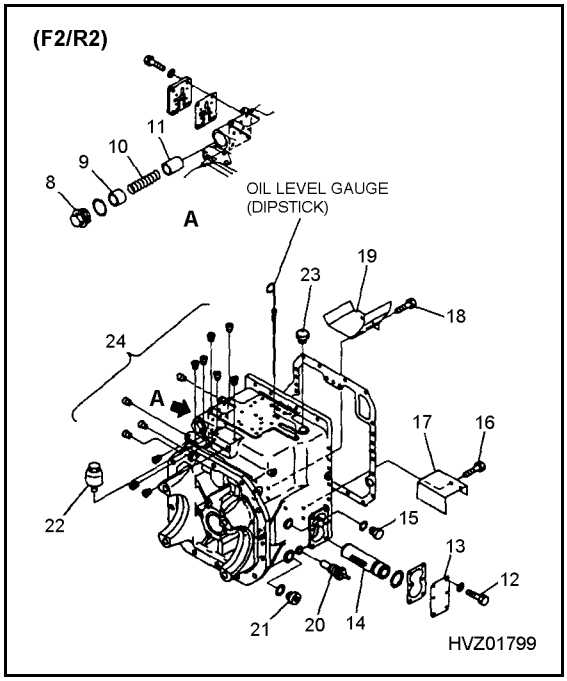
4) Strainer and plate
   A) Remove bolt (12) and plate (13) to pull out strainer (14)
   B) Remove bolt (16) to remove plate (17)
   NOTE: On F2/R1 trucks, also remove bolt (18) and plate (19)

5) Sensor
   A) Remove thermal-sensor (20)
   B) Remove plug (15)
   NOTE: On trucks equipped with optional speedometer, remove it now

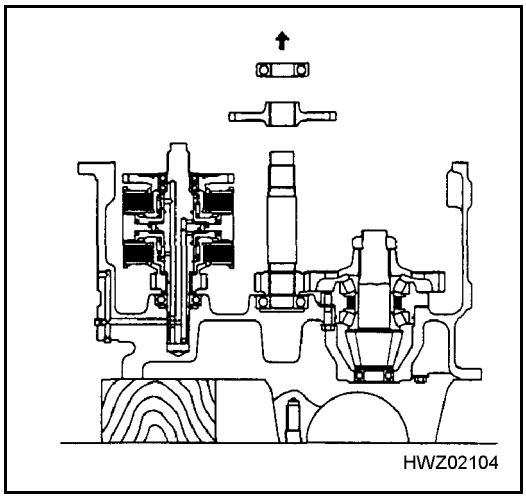


6) Accumulator
   A) Remove plug (8)
   B) Remove collar (9), spring (10) and piston valve (11)

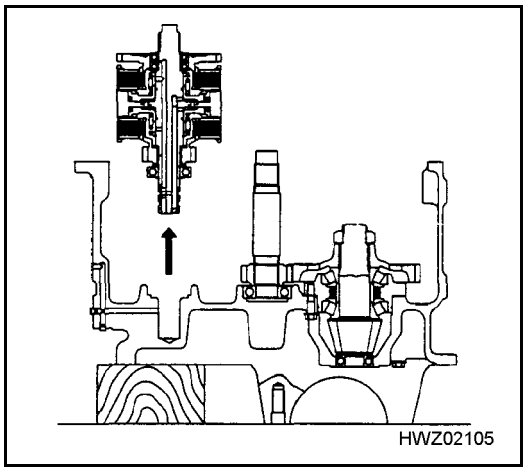
7) Plug, breather and cap
   A) Remove drain plug (21), breather (22) and cap (23)
   B) Remove blind plugs (24)
   NOTE: Number of blind plugs:
   F1/R1 trucks: 8
   F2/R1 trucks: 13



8) Removing the “large” gear from the intermediate shaft
   A) Remove the bearing from the intermediate shaft using a bearing puller
   B) Remove the gear
      For the F2/R1 truck, remove it as an intermediate shaft sub-assembly (including a clutch pack)



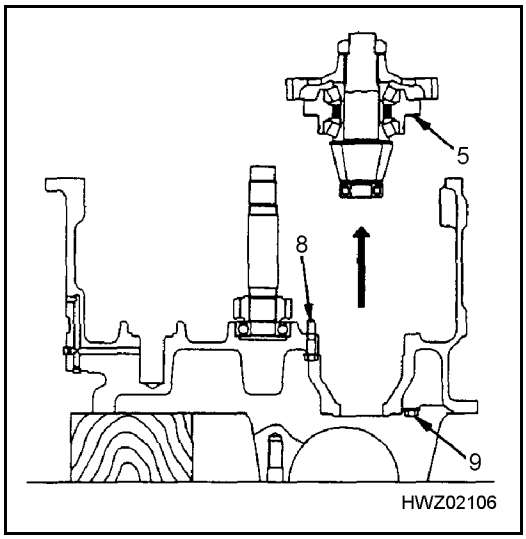
9) Input shaft sub-assembly
   (including a clutch pack assembly)



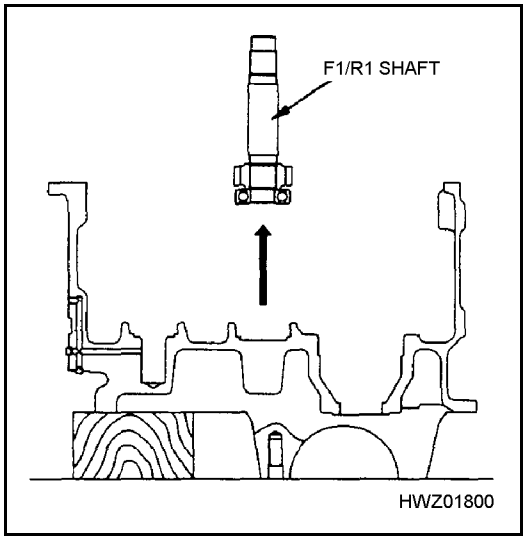
NOTE: The intermediate shaft can be removed as an intermediate shaft sub-assembly without removing the gear by removing the output shaft sub-assembly mounting bolt first in order to raise the output shaft sub-assembly.
Be sure to remove assemblies in sequence to avoid parts breakage and possible injury.

10) Output shaft sub-assembly
    A) Remove bearing cage support bolts (8) and (9) from the output shaft in order to remove the output shaft sub-assembly

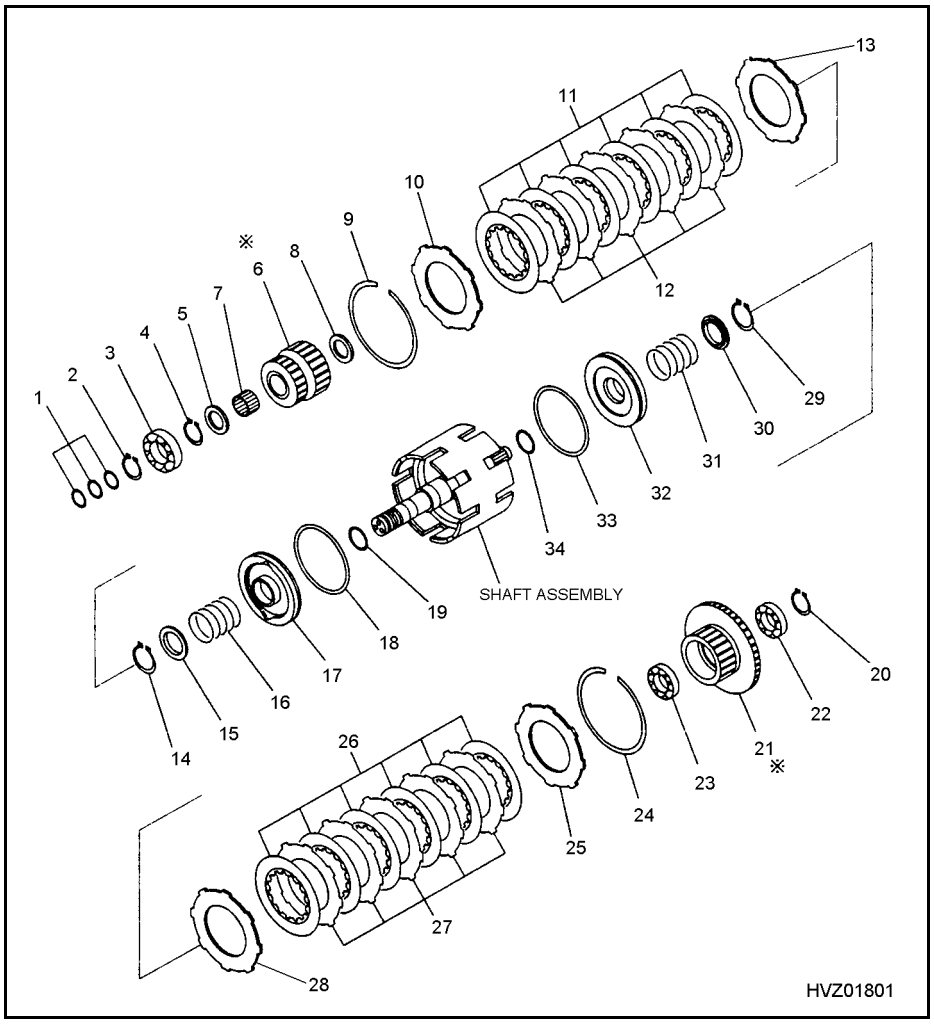
    NOTE: Store shims (5) between the transmission case and the cage. Keep them together by binding the shims with nylon tape or other suitable method



11) Intermediate shaft
    A) Remove the intermediate shaft (including the small gear and bearing)



12) Input shaft
Disassembly of clutch pack assembly
The numbers show the sequence for disassembly

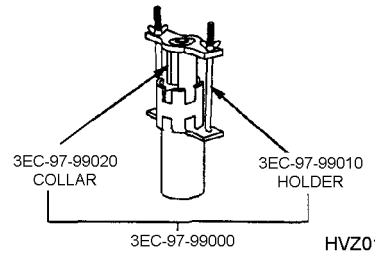


When removing snap rings (14) and (29), be aware that these rings are under strong tension. Use an appropriate tool for removal.

Snap ring tool	3EC-97-99000

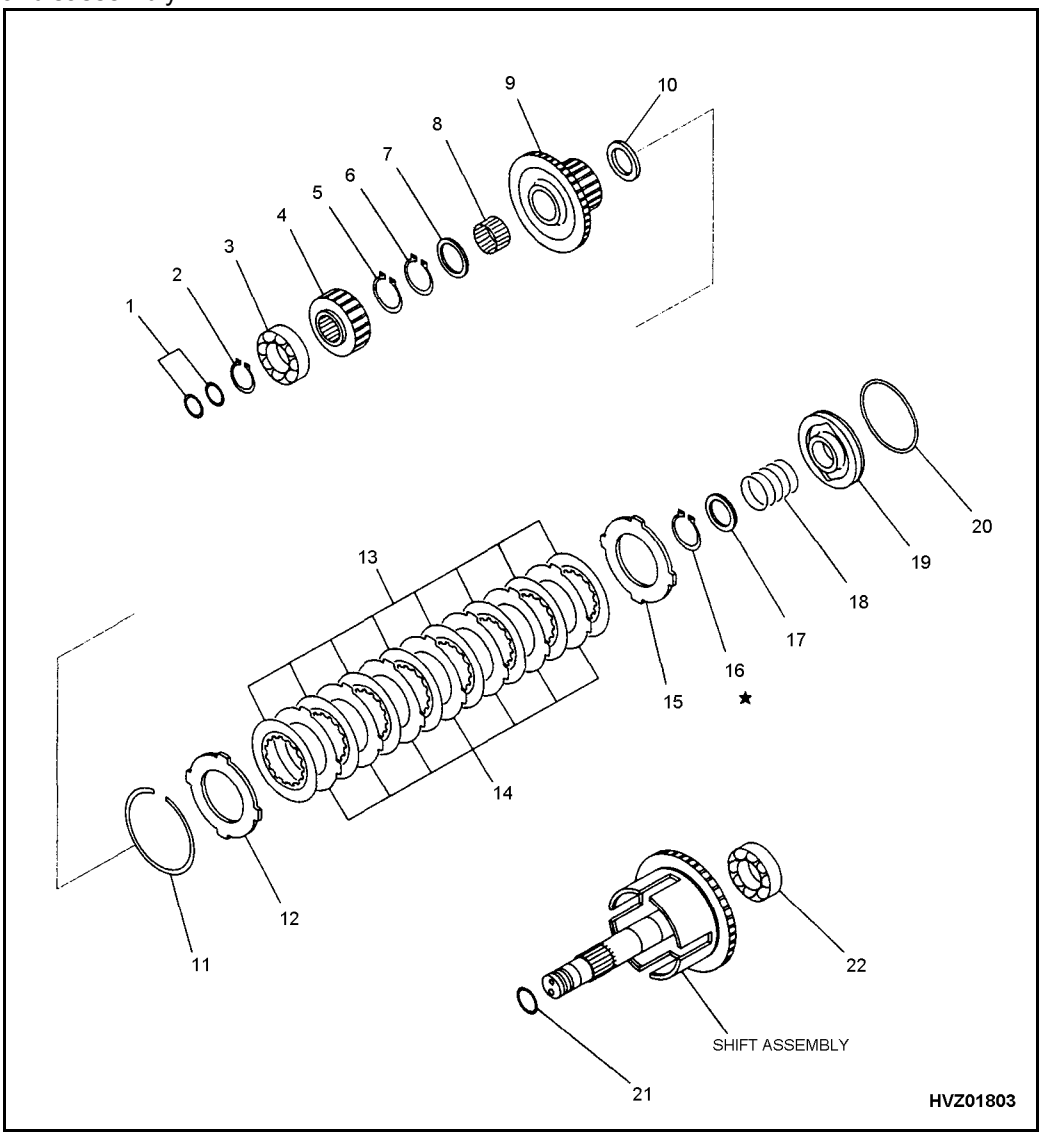
NOTE: When ordering parts, note that gears (6) and (21) are different depending upon type of lift truck

CAUTION



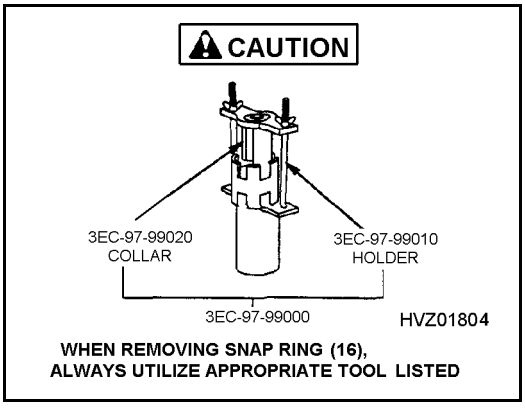
WHEN REMOVING SNAP RINGS (14) AND (29), ALWAYS UTILIZE APPROPRIATE TOOLS LISTED

13) Intermediate shaft (P100CX G/D: F2)
Disassembly of clutch pack
The numbers in the Figure display the sequence for disassembly

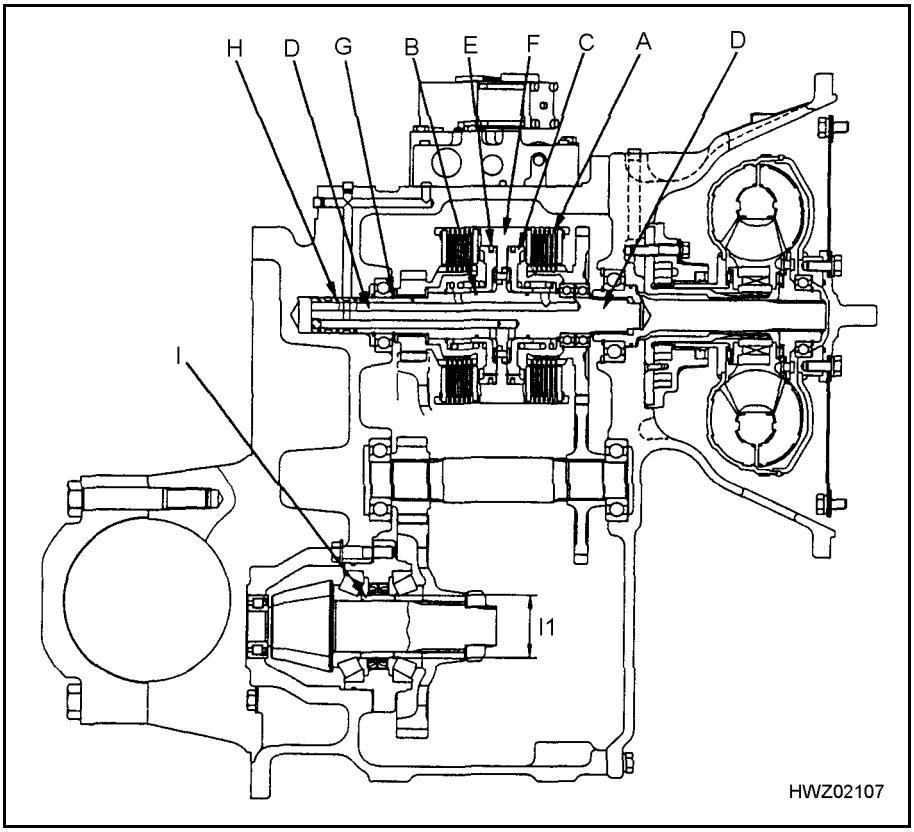


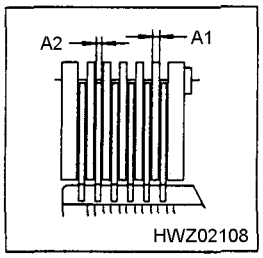
When removing snap ring (16), be aware this ring is under strong tension. Use an appropriate tool for removal.

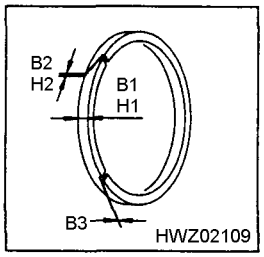
Snap ring tool	3EC-97-99000

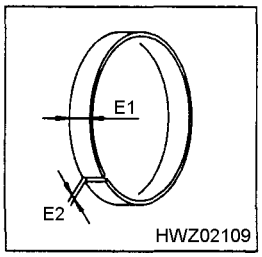


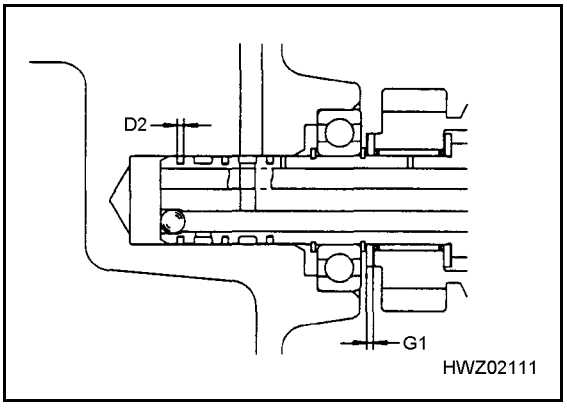
TESTING
(F1/R1 TRANSMISSION)(OUTDOOR LIFT TRUCK)

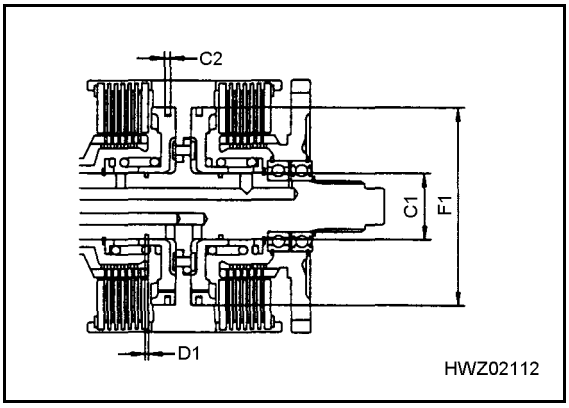








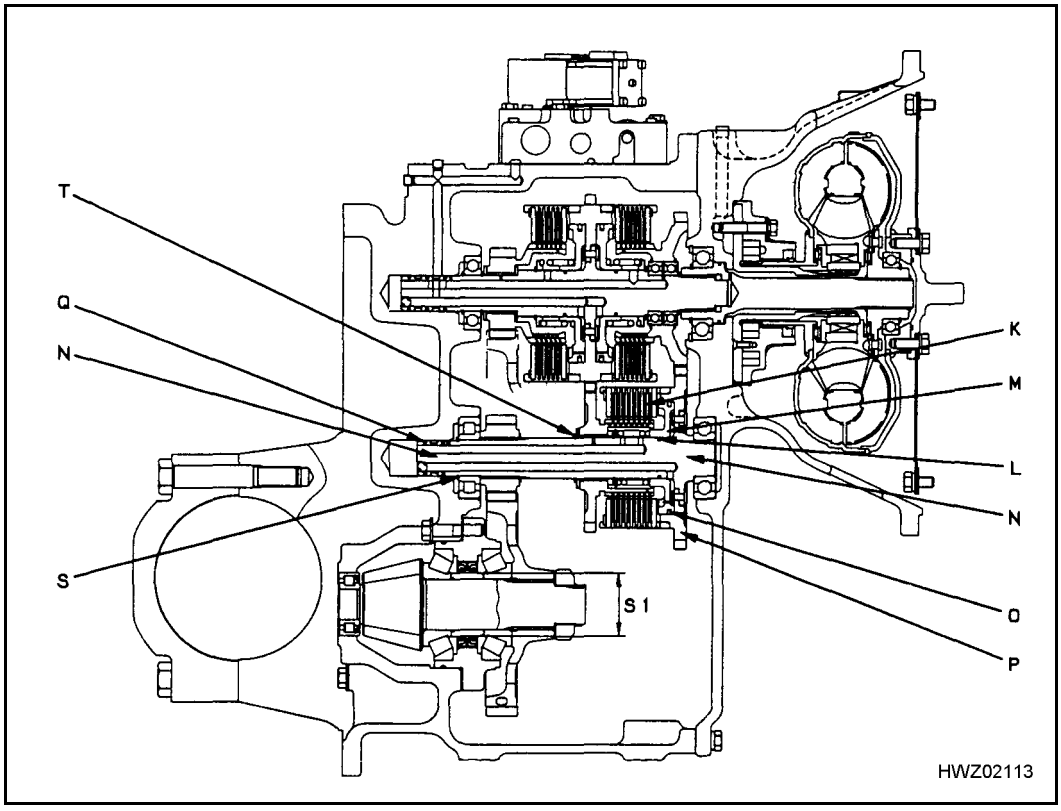


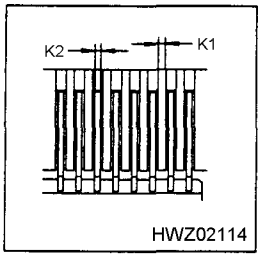


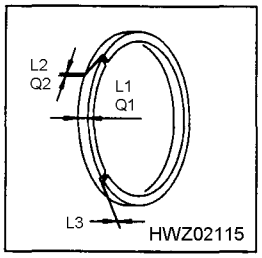
MAINTENANCE STANDARD
(F1/R1 TRANSMISSION) (OUTDOOR LIFT TRUCK)

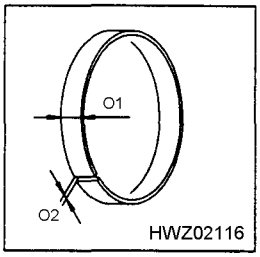
Symbol	Check item			Criteria		Remedy
				Standard size (mm)	Repair limit (mm)	
A	Plate	A1	Thickness of drive plate	2.5 – 2.7	2.3	Replace
		A2	Thickness of driven plate	1.93 – 2.07	1.7	
B	Seal ring	B2	Clearance at end gap when inserting piston	— (Bias cut)	—	Replace each time disassembly is carried out
		B3	Depth of oil groove in side face	—	—	
		B1 D1	Thickness	2.45 – 2.55	2.25	
C	Piston	C1	Inside diameter of seal ring contact surface	45 – 45.025	45.175	(No stepped-type wear should be detected) Replace
		C2	Seal ring insertion groove width	4.55 – 4.65	4.85	
D	Drive shaft	D1	Seal ring insertion groove width	2.6 – 2.65	2.8	
		D2	Seal ring insertion groove width	2.6 – 2.65	2.8	
H	Seal ring	H2	Clearance at end gap when inserting cap	— (Bias cut)	—	
		H1	Thickness	2.47 – 2.49	2.25	
		—	Diameter of transmission case 1st shaft hole	35 – 35.025	—	
E	Seal ring	E2	Clearance at end gap when inserting clutch case	0.3 – 0.5	1.2	
		E1	Width	4.47 – 4.49	4.23	
		(C2)	Insertion groove width	4.55 – 4.65	4.85	
F	Clutch case	F1	Inside diameter of seal ring contact surface	135 – 135.063	135.3	
G	Thrust washer	G1	Thickness	2.9 – 3.1	2.5	
I	Retainer	I1	Outside diameter of oil seal contact surface	59.926 – 60	—	(No stepped-type wear should be detected)
—	Gears	—	Backlash	0.14 – 0.41	—	
		—	Thrust clearance	0.15 – 0.6	—	
—	Gasket, O-ring, seals			—	—	Replace with new parts during disassembly and assembly

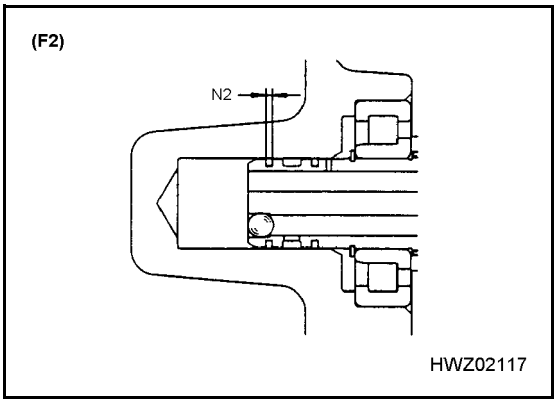
TESTING
(F2/R1 TRANSMISSION) (OUTDOOR LIFT TRUCK)

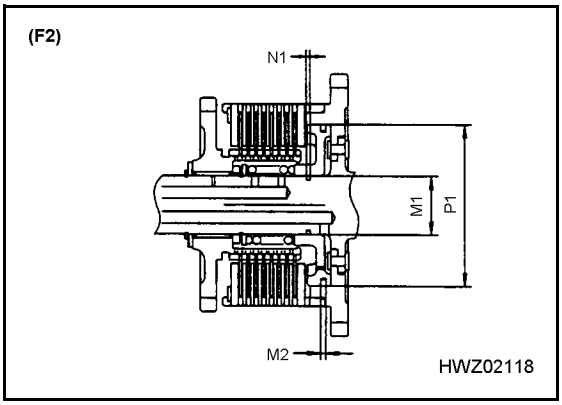










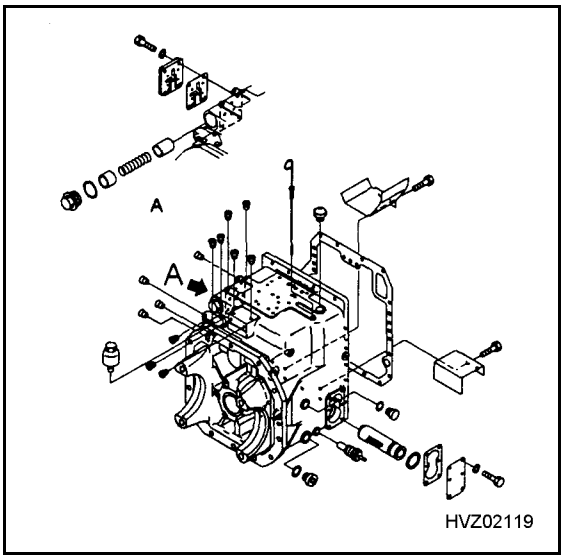


MAINTENANCE STANDARD
(F2/R1 TRANSMISSION) (OUTDOOR LIFT TRUCK)

Symbol	Check item			Criteria		Remedy
				Standard size (mm)	Repair limit (mm)	
K	Plate	K1	Thickness of drive plate	2.5 – 2.7	2.3	Replace
		K2	Thickness of driven plate	1.93 – 2.07	1.7	
L	Seal ring	L2	Clearance at end gap when inserting piston	— (Bias cut)	—	Replace each time disassembly is carried out
		L3	Depth of oil groove in side face	—	—	
		(L1)	Thickness	2.45 – 2.55	2.25	
M	Piston	M1	Inside diameter of seal ring contact surface	40 – 40.025	40.3	Replace
		M2	Seal ring insertion groove width	4.55 – 4.65	4.85	
N	Idle shaft	N1	Seal ring insertion groove width	2.6 – 2.65	2.8	
		N2	Seal ring insertion groove width	2.6 – 2.65	2.8	
O	Seal ring	O2	Clearance at end gap when inserting cap	0.3 – 0.5	1.2	
		O1	Thickness	4.47 – 4.49	4.23	
		(M2)	Insertion groove width	4.55 – 4.65	4.85	
P	Clutch case	P1	Inside diameter of seal ring contact surface	Min. 110		
T	Thrust washer	—	Thickness			
Q	Seal ring	Q2	Clearance at end gap when inserting clutch case	— (Bias cut)	—	
		Q1	Width			
		—	Diameter of transmission case 2nd shaft hole	35 – 35.025		
S	Retainer	S1	Outside diameter of oil seal contact surface			
—	Gears	—	Backlash	0.14 – 0.41	—	
		—	Thrust clearance	0.15 – 0.60	—	
—	Gasket, O-ring, seals			—	—	Replace with new parts during disassembly and assembly

PRECAUTIONS ON ASSEMBLY (OUTDOOR LIFT TRUCK)

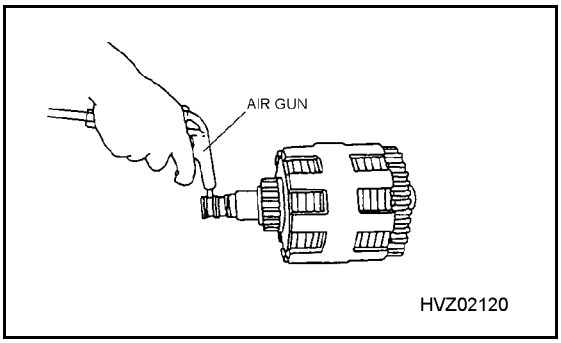
1) Cleaning each part
   A) Before assembly, completely clean the case bolt screw holes and oil path corners
   B) In particular, ensure that all threaded holes in the case are thoroughly cleaned
   Old Loctite, debris or other foreign matter may cause improper torque readings and can lead to bolt breakage



HVZ02119

2) Clutch pack assembly
   Blow compressed air through the oil hole to check drive plate alignment and driven plate operation

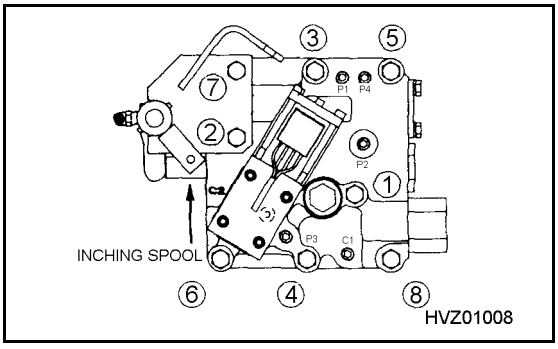
Air pressure	5 kg/cm^2 (70 psi)
Stroke	F: 4mm
Stroke	R: 4mm



HVZ02120

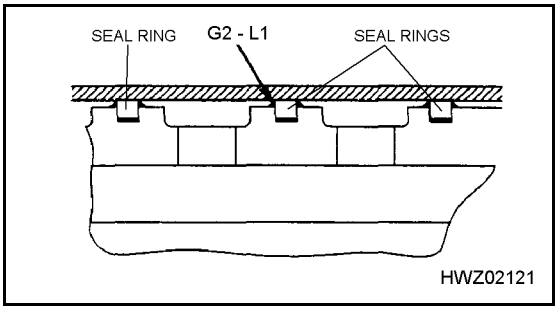
3) Control valve
   A) Tighten the mounting bolts in the order shown in the figure on the right

Torque	27 - 34 Nm (2.8 - 3.5 kgfm) (20 - 25 lb-ft)



HVZ01008

4) Seal ring
   During assembly, apply grease to the seal ring



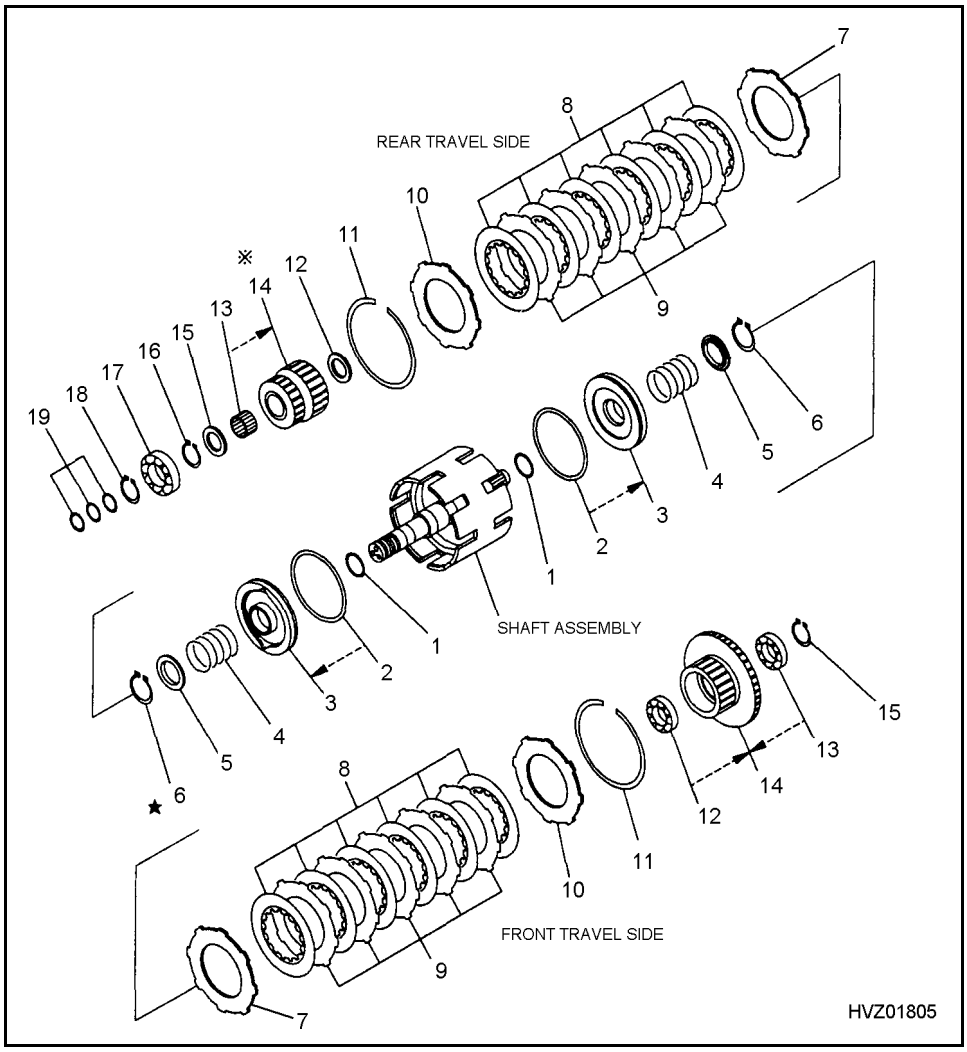
HWZ02121

ASSEMBLY OF FORWARD/REVERSE TRAVEL (INPUT SHAFT) SHAFT SUB-ASSEMBLY (OUTDOOR LIFT TRUCK)

(Assemble parts generally in the reverse order of disassembly)

NOTE: Dip the clutch plate and disc in oil before assembly

NOTE: Apply grease to the seal rings

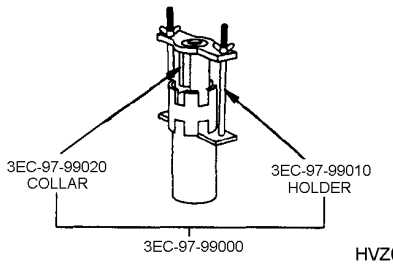


When removing snap ring (6), be aware that this snap ring is under pressure from spring (4). Always use specified tool to remove this spring.

Snap ring tool	3EC-97-99000

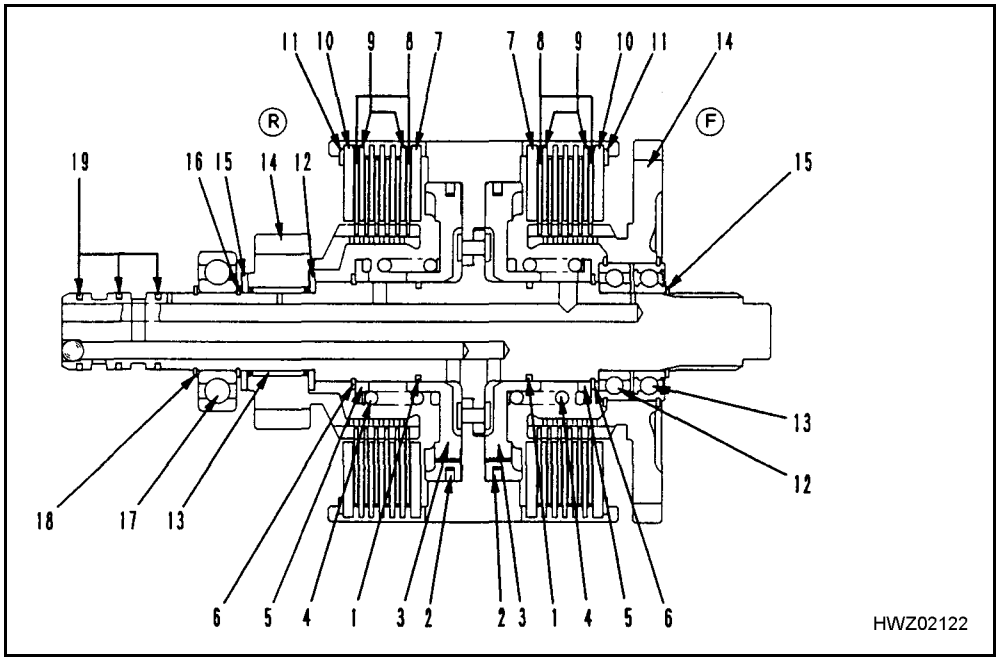
NOTE: Gear:
Compact truck: Z = 21
Standard truck: Z = 19

CAUTION



WHEN REMOVING SNAP RING (6), ALWAYS USE SPECIFIED SNAP RING TOOL

FLOWCHART FOR ASSEMBLY OF INPUT SHAFT (FOR F1/R1 AND F2/R1) SUB-ASSEMBLY (OUTDOOR LIFT TRUCK)



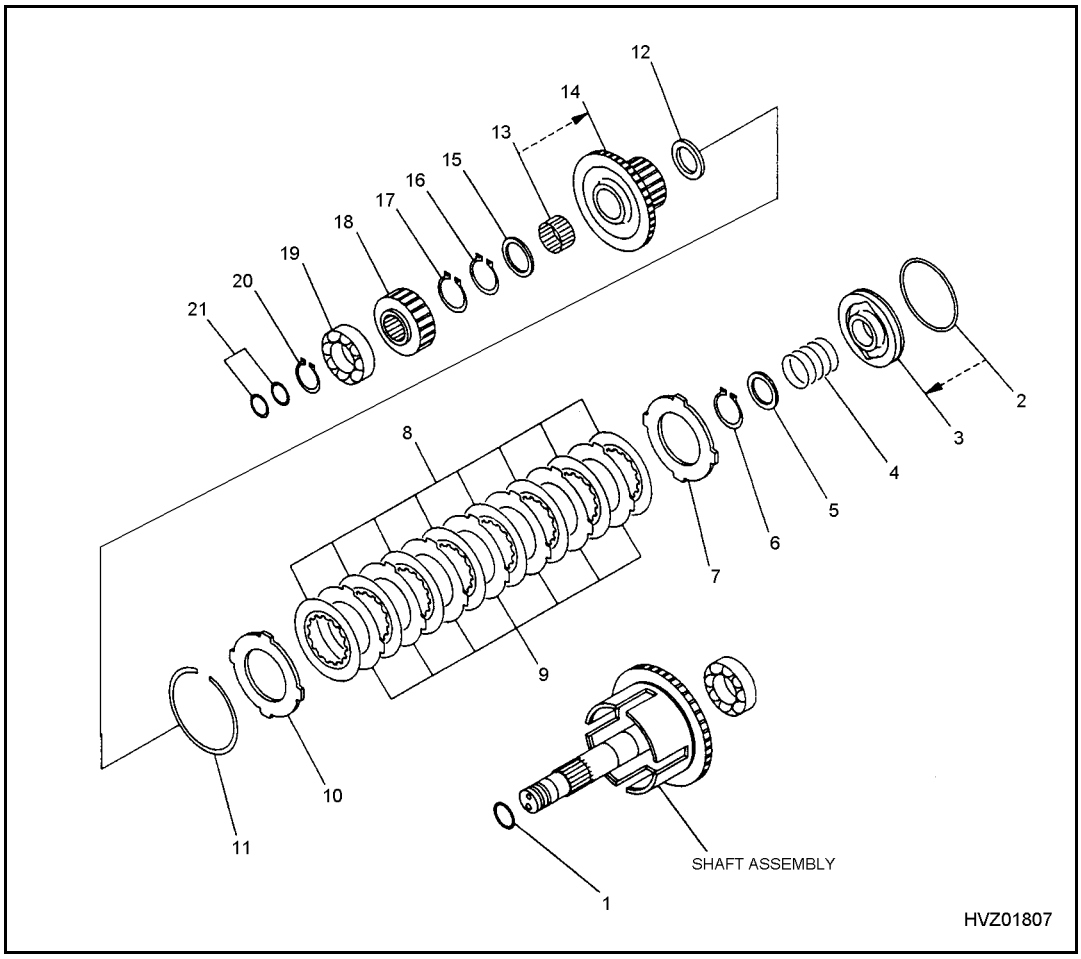
Assembling order	(Reverse travel side)	Input shaft	(Forward travel side)
1	Put the seal on the shaft.	Clutch pack	Put the seal on the shaft.
2	Put the seal ring on the piston and insert		Put the seal ring on the piston and insert the
3	the piston to the drum.		piston to the drum.
4	Insert the spring.		Insert the spring.
5	Insert the spacer.		Insert the spacer.
6	Fix it using a snap ring.		Fix it using a snap ring.
7	Insert the plate (t = 4.5 ± 0.1).		Insert the plate (t = 4.5 ± 0.1).
8	Insert the clutch disk and the plate (alter-		Insert the clutch disk and the plate (alterna-
9	natively). Disk (6) and plate (5)		tively). Disk (6) and plate (5)
10	Insert the plate (t = 4.5 ± 0.1).		Insert the plate (t = 4.5 ± 0.1).
11	Fix it using a ring.		Fix it using a ring.
12	Insert the spacer.		Assemble the gear and the bearing.
13	Assemble the gear and the bearing and in-		Assemble the gear and the bearing (*) and
14	sert the gear (Z = 19).		insert the gear (Z = 38).
15	Insert the washer.		Fix it using a snap ring.
16	Fix it using a snap ring.		
17	Insert the bearing.		
18	Fix it using a snap ring.		
19	Insert the seal ring.		

ASSEMBLY OF FORWARD TRAVEL 2ND SPEED (INTERMEDIATE SHAFT) SHAFT SUB-ASSEMBLY (OUTDOOR LIFT TRUCK)

(Assemble parts generally in the reverse order of disassembly)

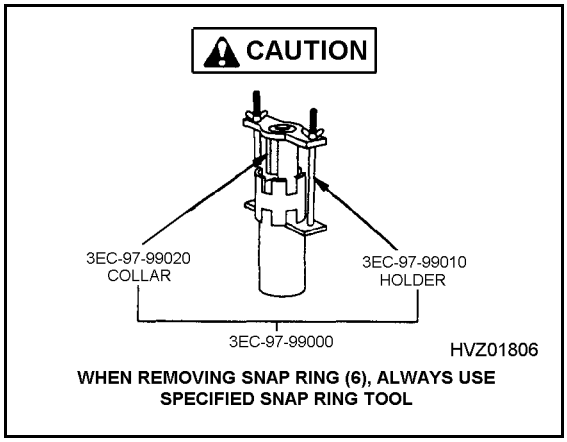
NOTE: Dip the clutch plate and disc in oil before assembly

NOTE: Apply grease to the seal rings

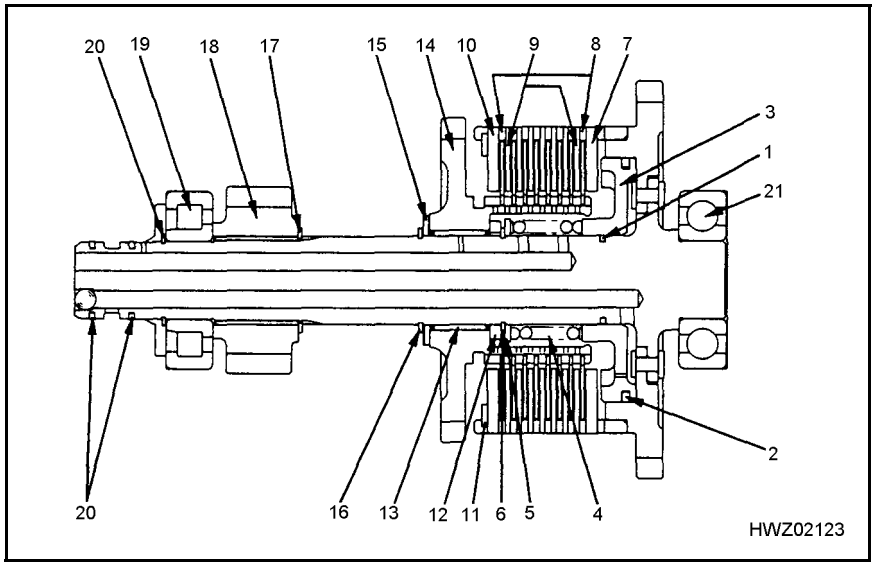


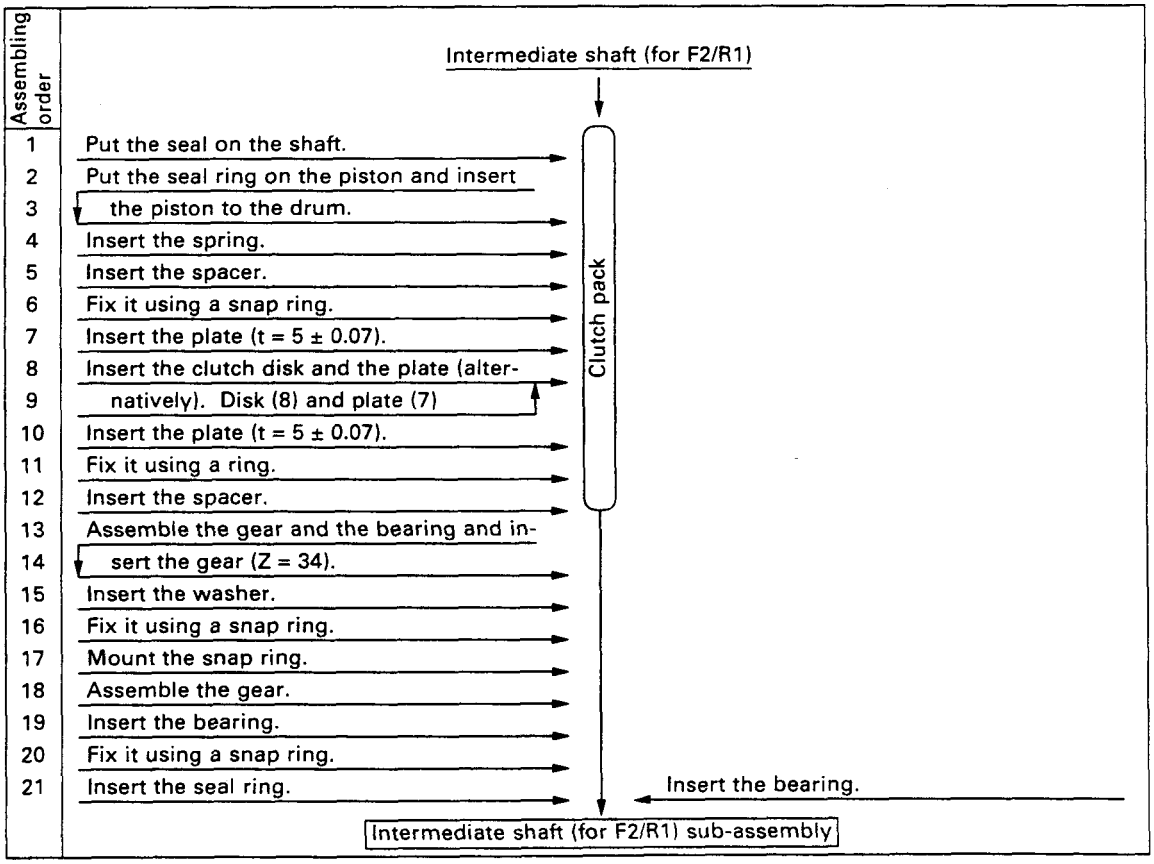
Use care when removing snap ring (6) as it is under tension from spring (4). Use the specified tool when removing snap rings.

Snap ring tool	3EC-97-99000

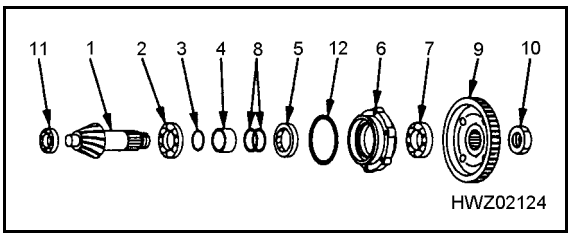


FLOWCHART FOR ASSEMBLING INTERMEDIATE SHAFT (F2/R1) SUB-ASSEMBLY (OUTDOOR LIFT TRUCK)





ASSEMBLY OF OUTPUT SHAFT SUB-ASSEMBLY (OUTDOOR LIFT TRUCK)
(Assemble parts generally in the reverse order of disassembly)



1) Install the inner race of bearing (2) to pinion shaft (1)

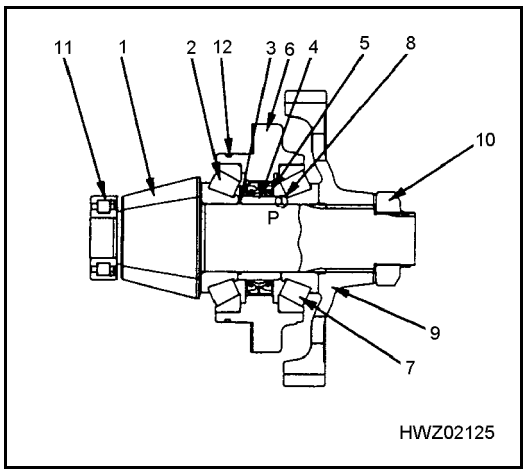
2) Install O-ring (3) to the inner race of bearing (2) by pressing the ring to the race to install race (4)
   NOTE: Assemble race (4) so that the tapered side faces the spline

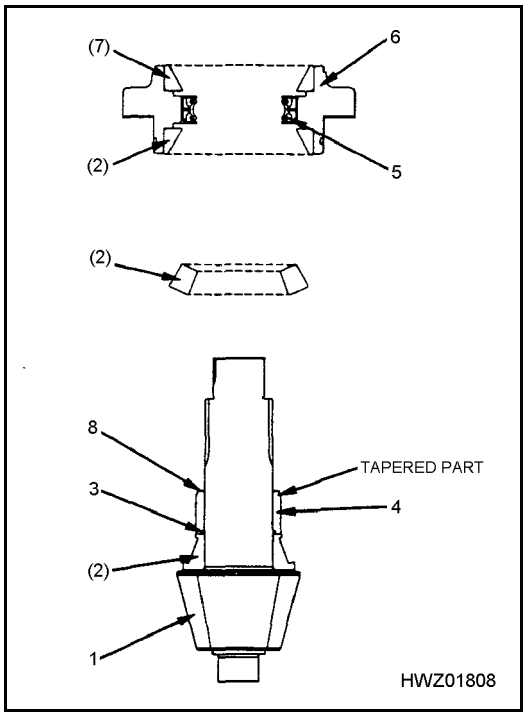
3) Install oil seal (5) to cage (6) and put the outer races of bearings (2) and (7) to both sides
   NOTE: Assemble the seal so that the rounded side on the back faces the pinion
   NOTE: After assembling the seal, apply lithium grease to the lip

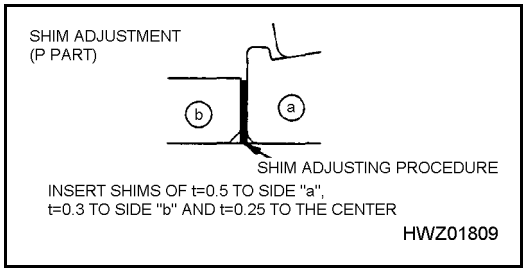
4) Mount shim (8)
   NOTE: Refer to the thickness of the disassembled shim(s)
   See “Shim Adjustment” (P part)

5) Engage the roller of bearing (2) with the inner race installed on pinion shaft (1)

6) Install cage (6) with oil seal (5) and the outer races of bearings (2) and (7) assembled on the pinion shaft







7) Engage the roller of bearing (7) with the outer race in cage (8)

8) Assemble the inner race of bearing (7)
NOTE: Make sure that the adjustment shim has been installed before assembling the inner race

9) Assemble gear (9) (Z = 54)
Compact truck: Z = 53
Standard truck: Z = 54

10) Mount and tighten nut (10)

Tightening torque	314 - 441 Nm (32 - 45 kgfm) (231.6 - 325.3 lbft)

NOTE: After tightening nut (10) to the specified torque, make sure that the starting torque of pinion shaft (1) is within the following range:

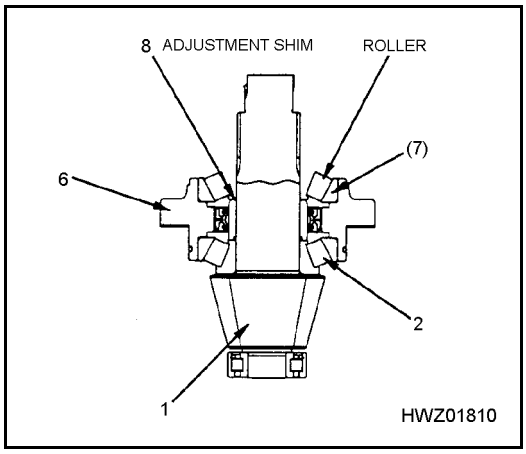
Starting torque	4 - 8 Nm (40 - 80 kgfm) (3 - 6 lbft)

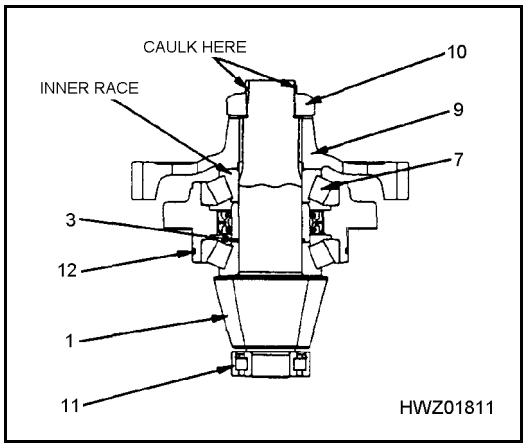
NOTE: If the starting torque does not fall within the range above, adjust shim (8) again to obtain a proper torque reading

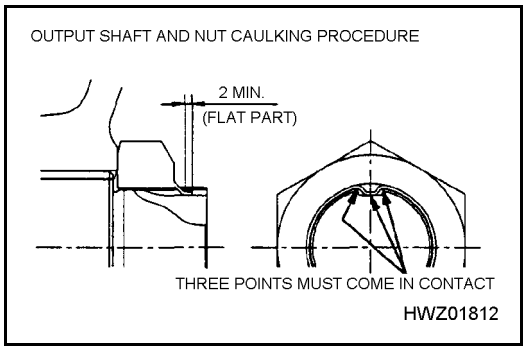
11) After adjusting the pinion shaft starting torque, caulk nut (10)

12) Assemble and caulk bearing (11)
Caulk three positions on the circumference (at equal intervals) using a punch so that it comes in contact with the bearing inner race scale

13) Install O-ring (12) on the O-ring groove of cage (6)





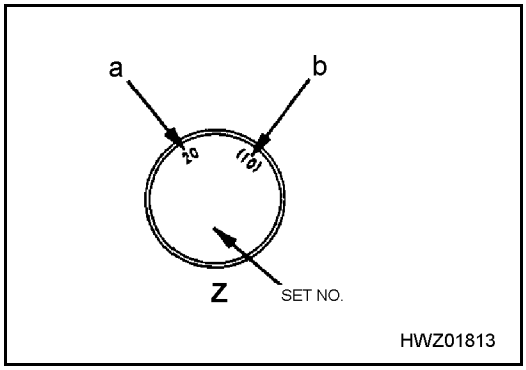


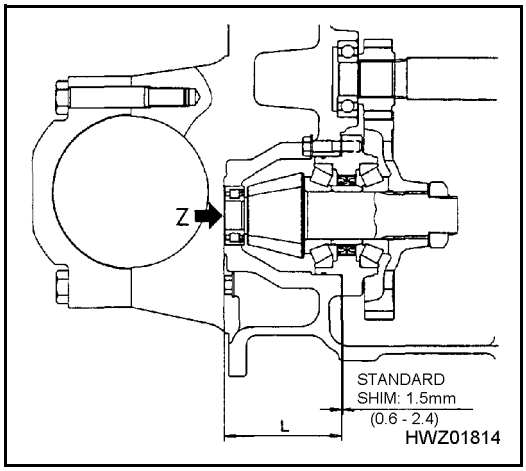
ADJUSTING OUTPUT SHAFT SUB-ASSEMBLY (PINION SHAFT THRUST PROTRUSION)

1) Shim between the bearing cage and the transmission
   Calculate the thickness using the following formula to obtain pinion shaft protrusion (standard shim = 1.2mm):

Shim thickness T = 0.30 + $\frac{a + b + c + d}{100}$

- a and b: Numbers on the pinion shaft end
  Adjust the protrusion using the shim after adjusting the starting torque of the output shaft sub-assembly.
- c: Value expressing the difference against the standard length of 120.82mm in 1/100 units after measuring length L.
- d: Read the value stamped on the transmission case (for housing the bearing on the pinion shaft end). (Example: “25”)

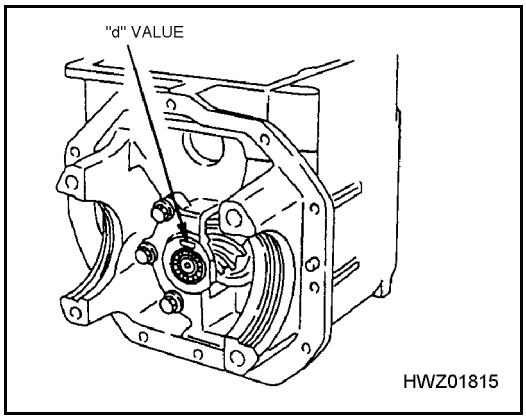




2) Example of shim calculation
   a = 20 (stamped value on pinion)
   b = 10 (stamped value on pinion)
   (the following shows measurement calculation)
   c = (L - 120.82) x 100 = (121.39 - 120.82 x 100)
   = 57 (e.g.: L = 121.39)
   d = 25 (stamped value on transmission case)

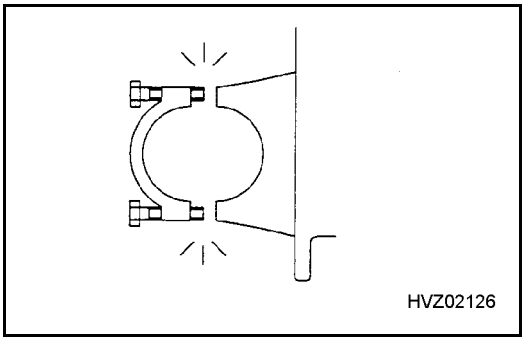
Shim thickness T = $\frac{0.3 + 20 + 10 + 57 + 25}{100}$

= 1.42mm

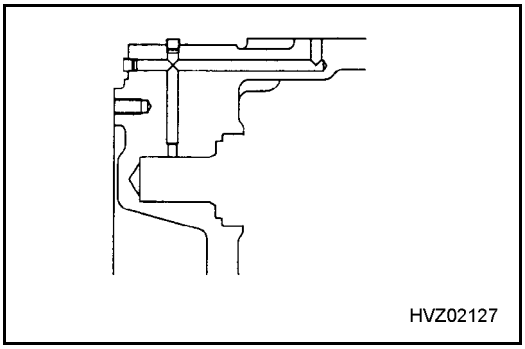


ASSEMBLY

1) Cleaning the transmission case and blowing out with compressed air
   A) Remove the cap before cleaning the transmission case (since Loctite is used on the cap mounting bolts)

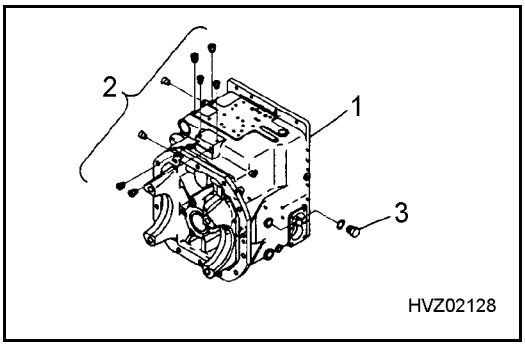

HVZ02126

   B) Blow out the machined hole in the case with compressed air

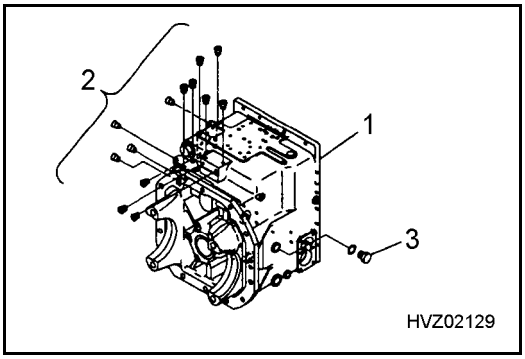

HVZ02127

2) Installing blind plugs on the transmission case
   NOTE: For lift trucks equipped with an optional speed meter, which uses a speed sensor, mount the sensor after assembling the output, intermediate and input shafts

   NOTE: Number of blind plugs (2)
   - F1/R1 truck: 8
   - F2/R1 truck: 13

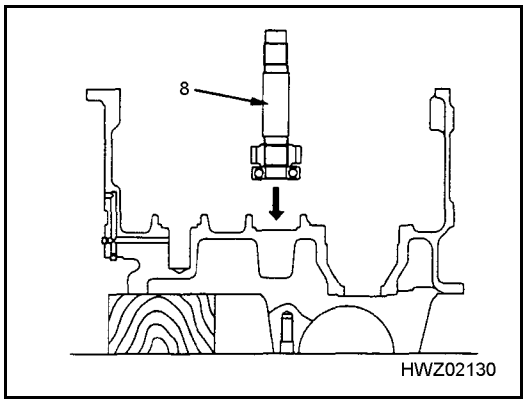


HVZ02128



HVZ02129

3) Intermediate shaft
   A) Assemble the intermediate shaft (8)
   • Install the gear (large) and the bearing on the torque converter case side after assembling the input shaft sub-assembly

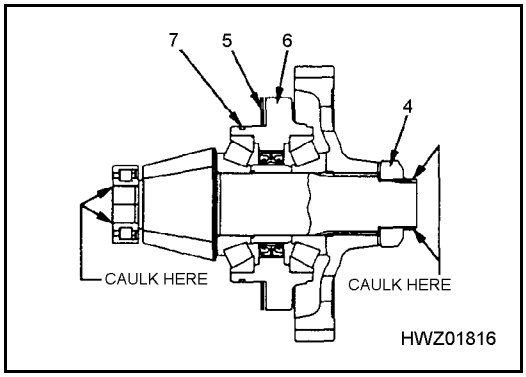


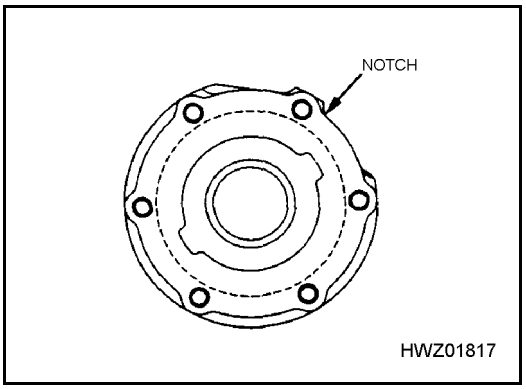
4) Output shaft sub-assembly
   • Make sure that nut (4) has been fully caulked
   • Make sure that the bearing on the pinion end has been fully caulked after installation

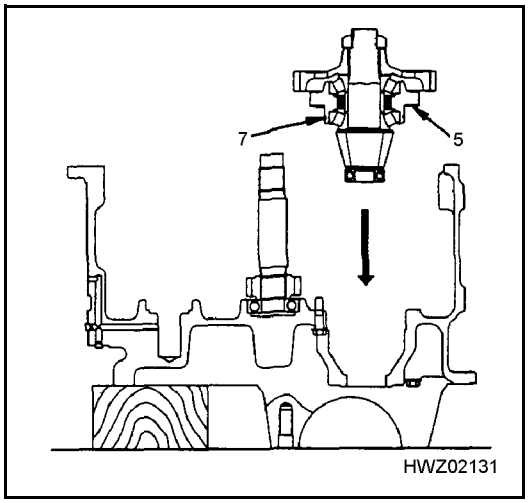
   A) Install shim (5) and O-ring (7) on cage (6) of the output shaft sub-assembly and install them on the transmission case

   • Standard shim thickness: 1.5mm (0.6 - 2.4)

   • Shim mounting position:
   Mount the shim in such a manner that it comes in contact with the notch on the case boss

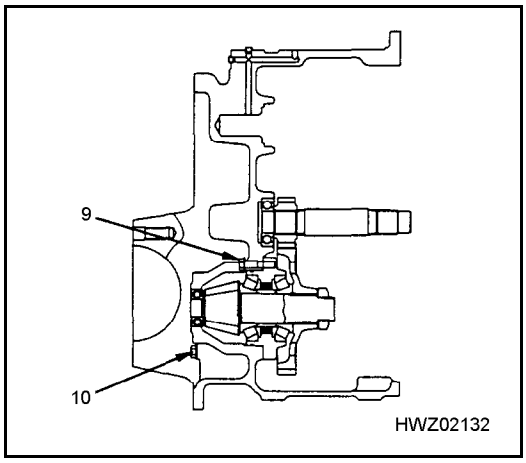




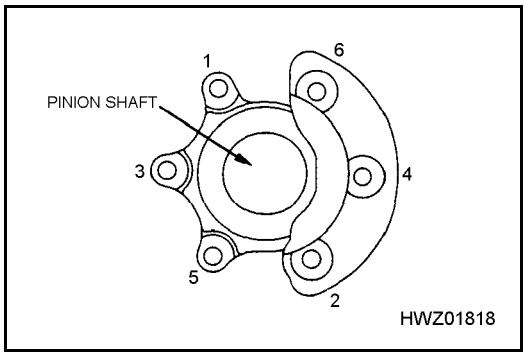


B) After assembling the output shaft sub-assembly, tighten bolts (9) and (10) from the differential side

Apply Loctite to bolts (9) and (10)	Loctite #271 (hole-side screw)
Initial torque	49 - 74 Nm (5 - 7.5 kgfm) (36 - 54.6 lbft)
Final torque	98 - 123 Nm (10 - 12.5 kgfm) (72 - 90.7 lbft)



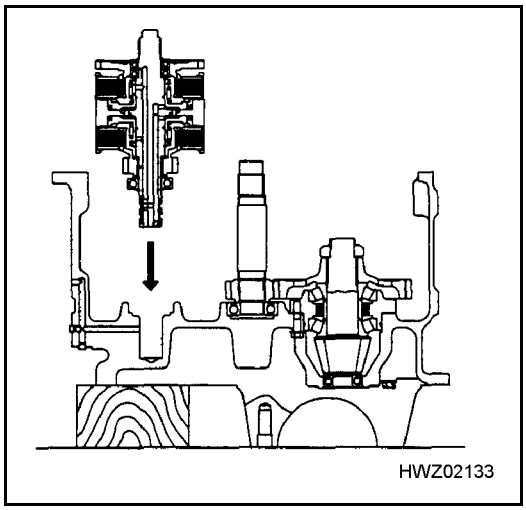
- Tightening order
  Tighten bolts in a diagonal pattern
- If pinion shaft is harder to rotate after tightening the bolts than it was prior to assembly, remove the output shaft sub-assembly and readjust the bolts



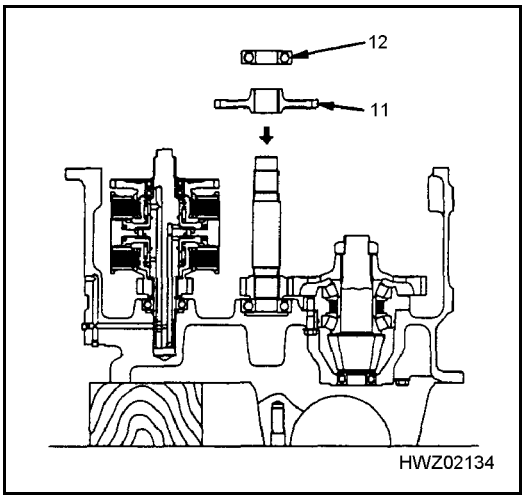
5) Input shaft sub-assembly
(Assembling the input shaft sub-assembly)
Refer to pages 30-22 and 3-23

A) Slowly engage the input shaft sub-assembly with the intermediate shaft gear in such a manner as to avoid damaging the seal ring and insert the shaft end into the transmission case shaft hole

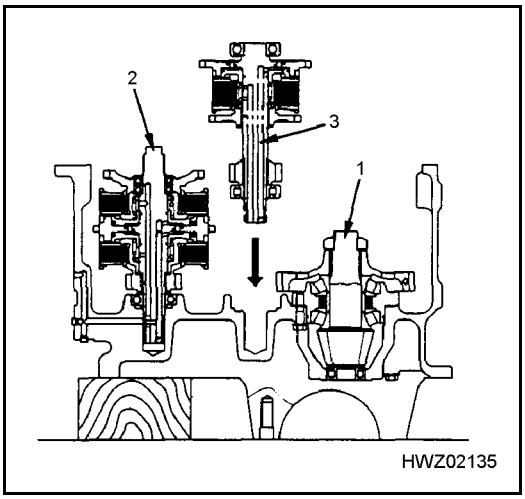
- Apply grease (G2-LI) to the seal ring



6) Intermediate shaft gear (large) and bearing
   A) Engage intermediate shaft gear (11) with the input shaft sub-assembly gear and install them on the intermediate shaft
   B) Assemble bearing (12) and press-fit in place
   • Be sure to use a copper bar or a jig when press-fitting the bearing



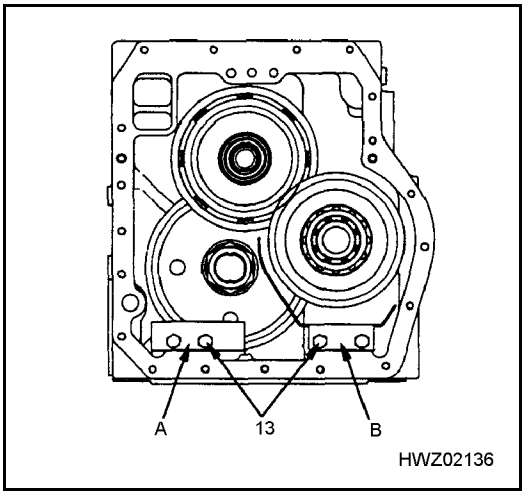
7) Assembling the F2/R1 lift truck and the transmission
   A) Assemble output shaft sub-assembly (1)
   B) Assemble input shaft sub-assembly (2)
   C) Assemble intermediate shaft sub-assembly (3)
   NOTE: Follow the reverse procedure for disassembly



8) Installing the plate
   Install plates A and B using bolts (13)

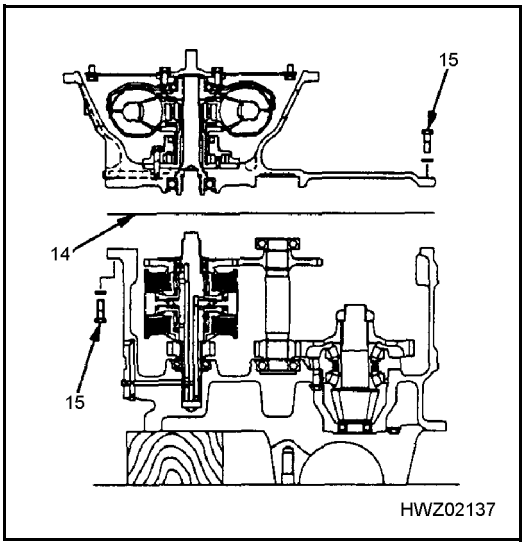
Apply Loctite	Loctite #271 (screw)
Torque bolts	59 - 73 Nm (6 - 7.7 kgfm) (43.5 - 53.8 lbft)

NOTE: P90CX G/D: Plate A (F1/R1)
P100CX G/D: Plate A and B (F2/R1)

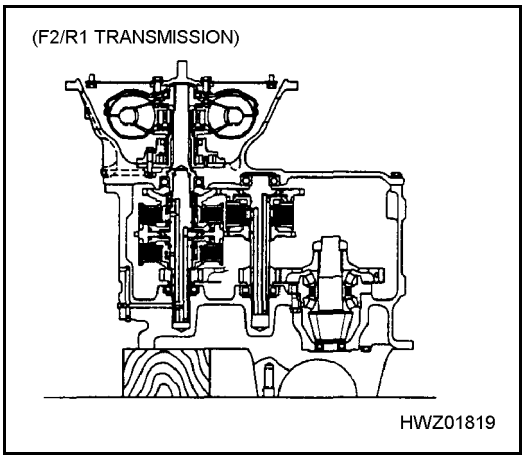


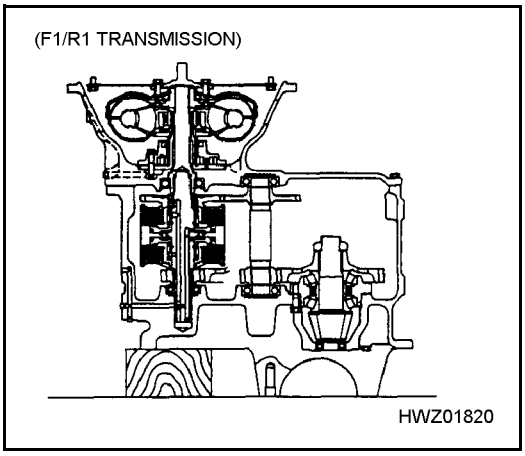
9) Installing the torque converter assembly
   A) Set gasket (14) on the transmission case
   B) Align the torque converter assembly with the transmission case dowel pin and slowly bring them together
   C) Tighten bolts (15)

Torque bolts	59 -73 Nm (6 - 7.7 kgfm) (43.4 - 53.8 lbft)



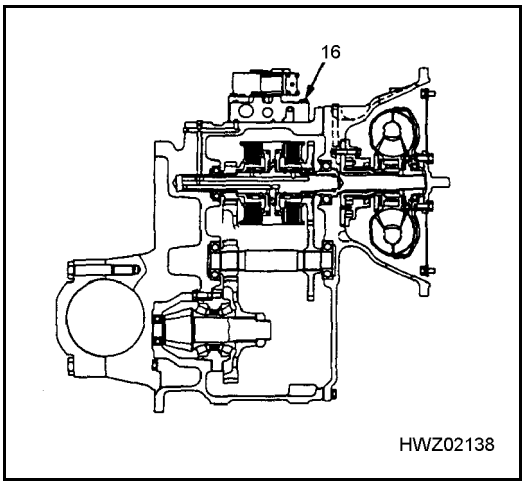
If the transmission case and the torque converter housing cannot be easily joined due to misalignment of the input shaft spring or the intermediate shaft bearing, do not force them together by tightening the bolts. Gently tap on the housing with a wooden hammer or similar tool and then tighten bolts (15).



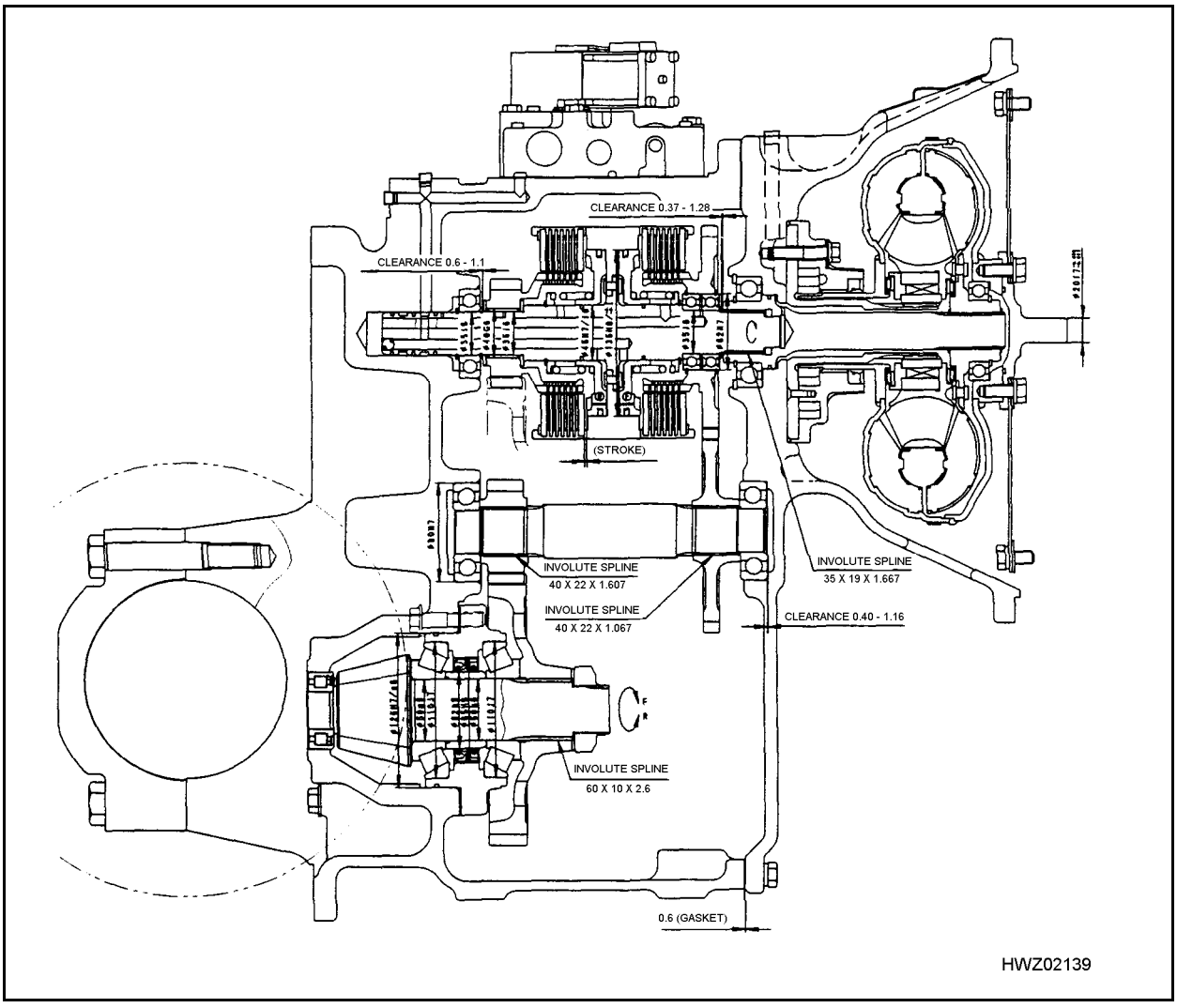


10) Installing the transmission valve
Install it using bolts (16) and gaskets (tighten two of the eight bolts together with inching change brackets)

Torque bolts	27 - 34 Nm (2.8 - 3.5 kgfm) (20 - 25 lbft)

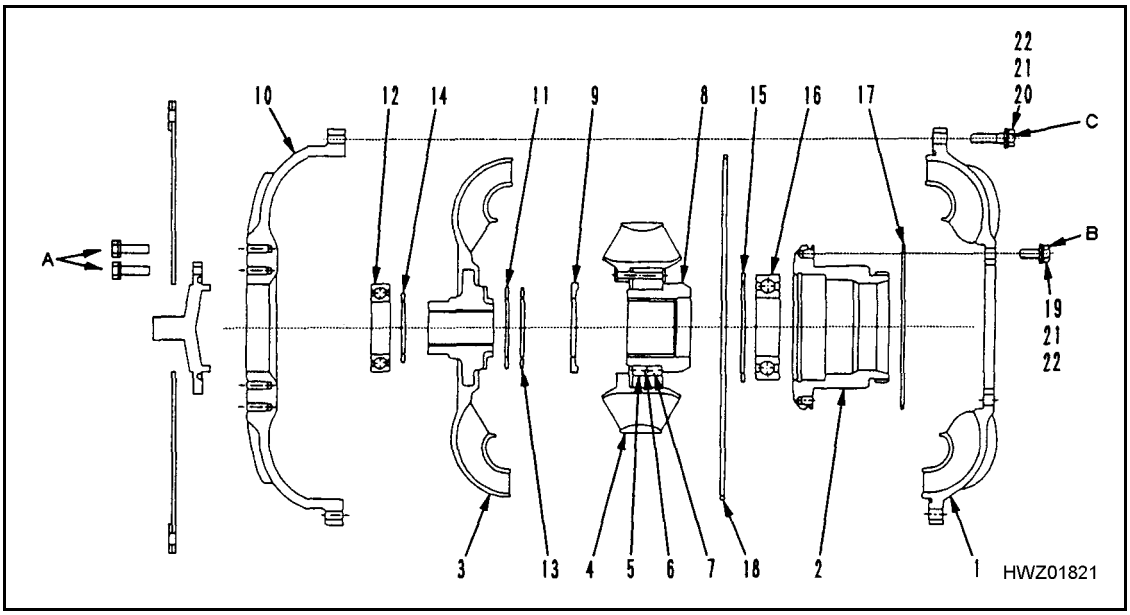


TORQFLOW TRANSMISSION ASSEMBLY DRAWING (F1/R1)



TORQUE CONVERTER (INDOOR LIFT TRUCK)

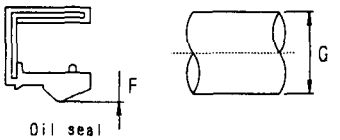
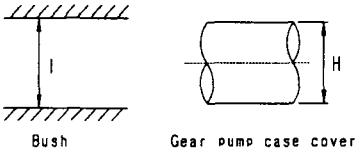
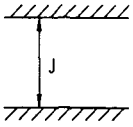
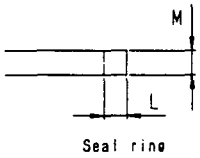
STRUCTURE

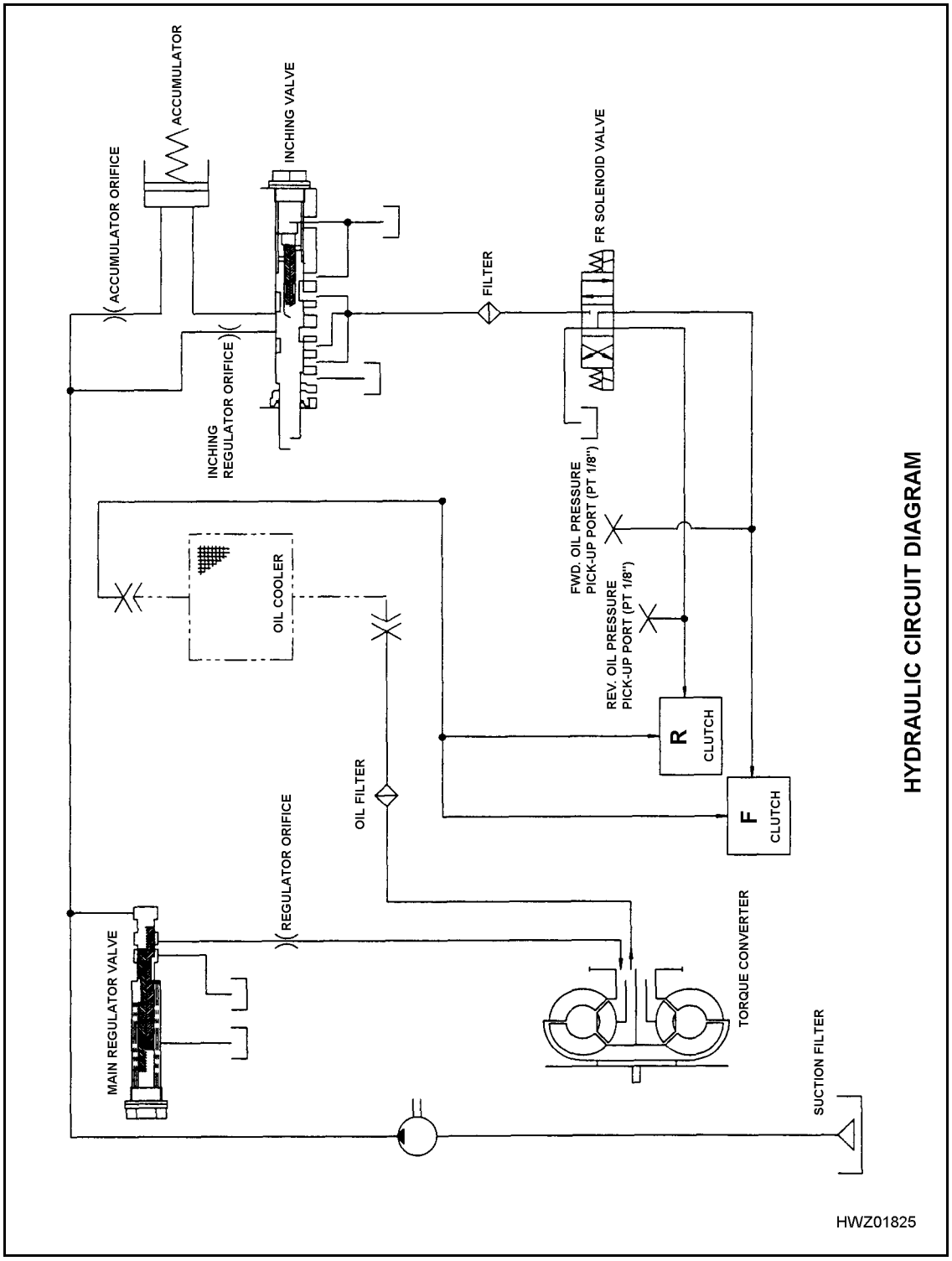


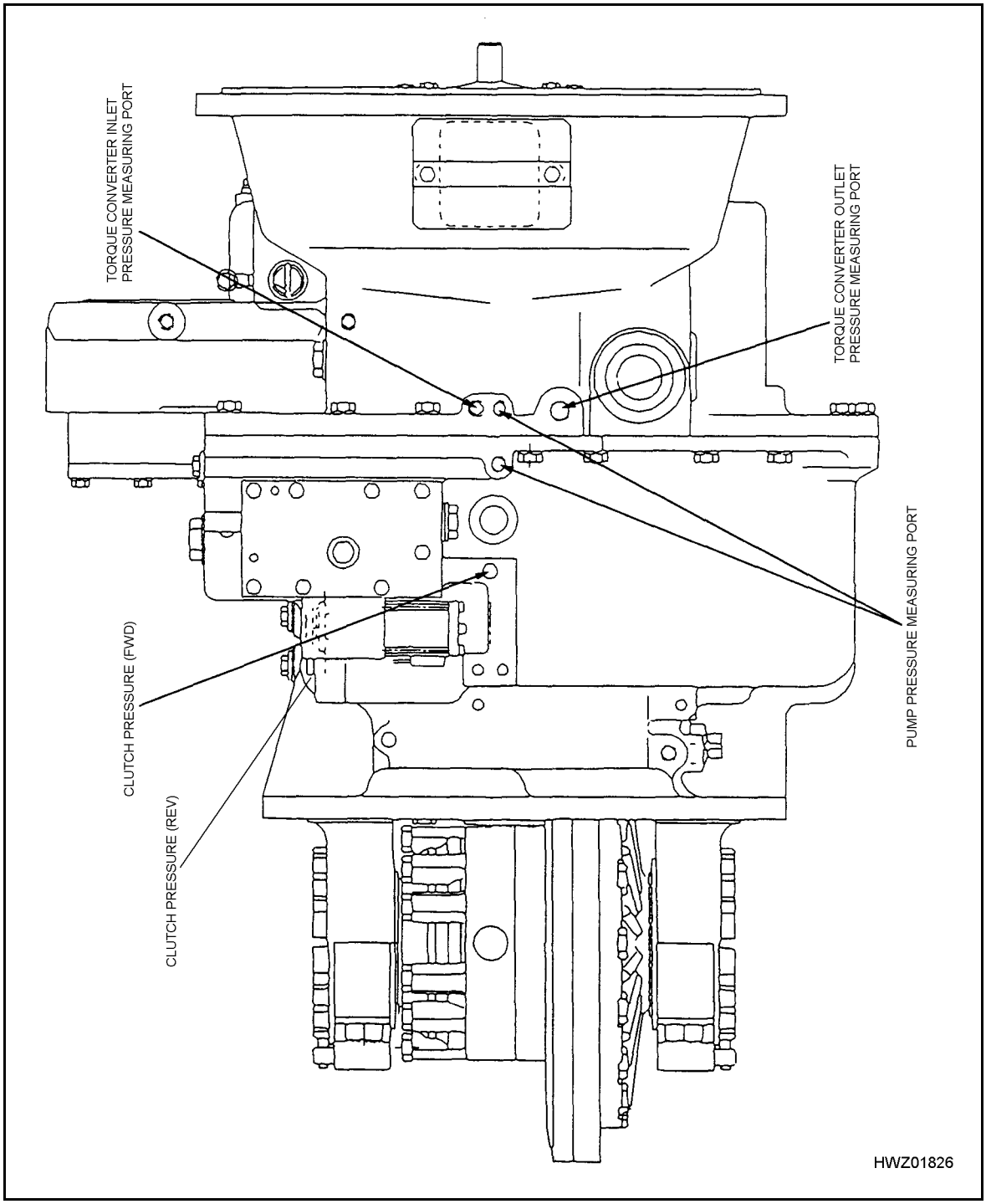
No.	Part name	No.	Part name
1	Pump	12	Bearing
2	Pump boss	13	Thrust needle bearing
3	Turbine assembly	14	Spacer
4	Stator assembly	15	Snap ring
5	Roller	16	Bearing
6	Spring	17	O-ring
7	Spring cap	18	O-ring
8	Hub	19	Bolt
9	Thrust washer	20	Bolt
10	Drive cover	21	Spring washer
11	Thrust washer	22	Washer

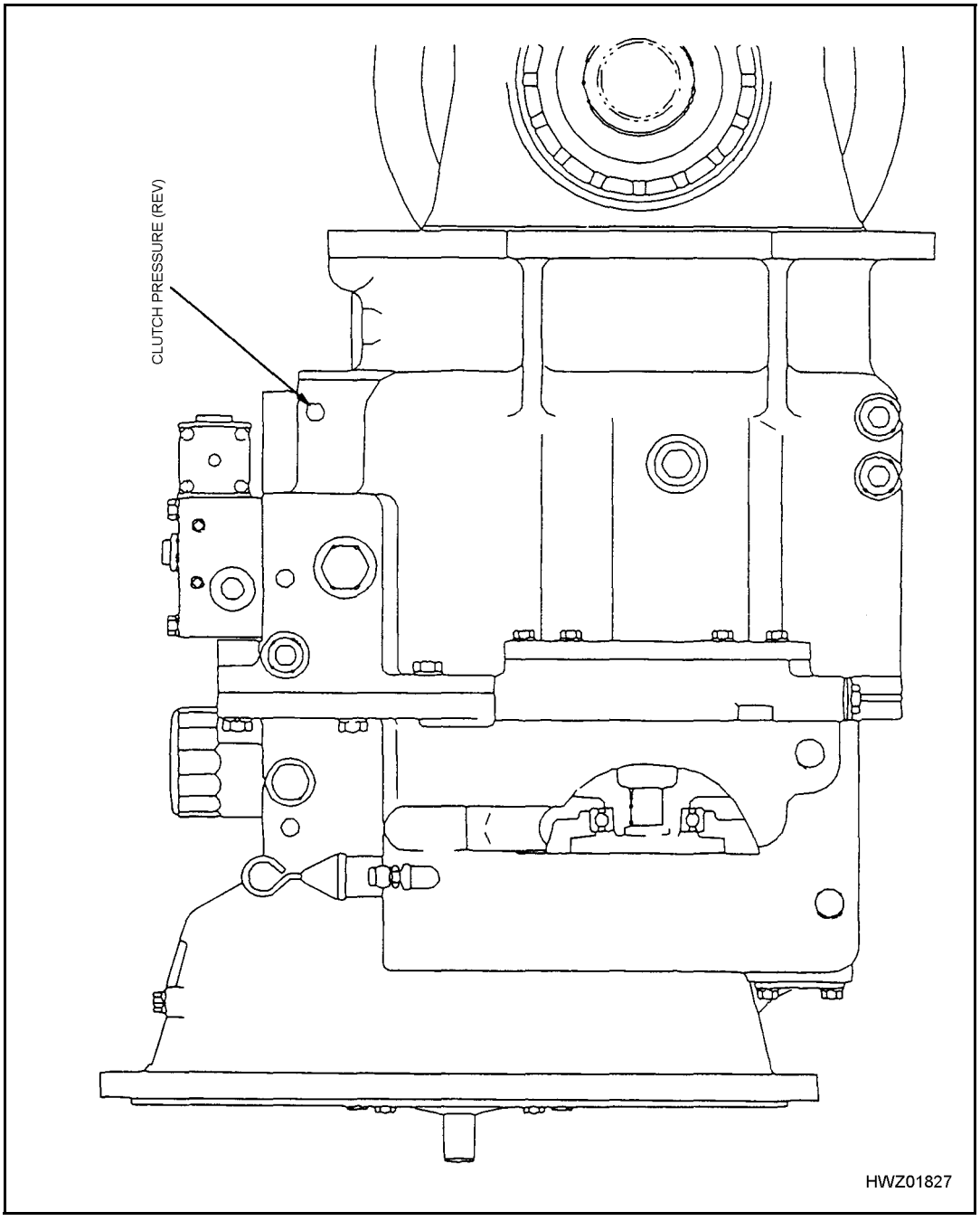
Tightening torque:

Bolt A, B and C: 18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.0 lbft)

No.	Check item	Criteria		Remedy
		Standard size (mm)	Allowable limit (mm)	
1	Gear pump			Replace
	Oil seal and pump boss  HWZ01822	A mm B mm Clearance mm	– 104.965 – 105.0	Replace at disassembling 104.8
	Bush and gear pump case cover  HWZ01823	A mm B mm Clearance mm	 54.951 – 54.970 55 – 55.03 0.03 – 0.079	 – – 0.13
2	Converter case			
	Inside diameter of converter case (sealing contact surface)  HWZ01824	J mm	35	35.15
	Seal ring  HWZ01792	L mm M mm	1.9 2.0	1.42 1.43


HYDRAULIC CIRCUIT DIAGRAM
ACCUMULATOR
ACCUMULATOR ORIFICE
INCHING VALVE
FILTER
FR SOLENOID VALVE
INCHING REGULATOR ORIFICE
FWD. OIL PRESSURE PICK-UP PORT (PT 1/8")
REV. OIL PRESSURE PICK-UP PORT (PT 1/8")
OIL COOLER
R CLUTCH
F CLUTCH
OIL FILTER
REGULATOR ORIFICE
MAIN REGULATOR VALVE
TORQUE CONVERTER
SUCTION FILTER
HWZ01825


TORQUE CONVERTER INLET PRESSURE MEASURING PORT
TORQUE CONVERTER OUTLET PRESSURE MEASURING PORT
PUMP PRESSURE MEASURING PORT
CLUTCH PRESSURE (FWD)
CLUTCH PRESSURE (REV)
HWZ01826


CLUTCH PRESSURE (REV)
HWZ01827

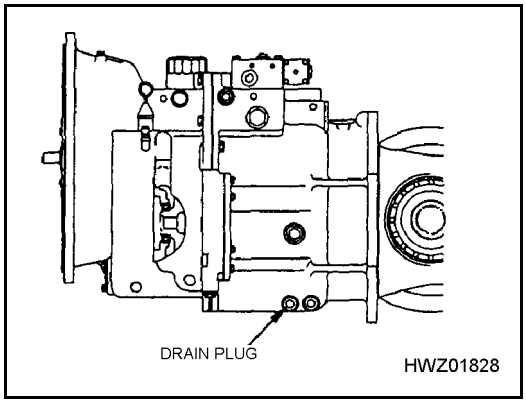
TROUBLESHOOTING

No.	Problem	Causes	Remedy
1	Power is not transmitted	A No hydraulic pressure	
		1) Low oil level	Refill oil
		2) Damage to the gear pump or damage to the drive section	Disassemble and replace parts or assembly as necessary.
		3) Damage to the line or joint	Disassemble and replace.
		4) Broken piston in the inlet relief valve or broken spring	Disassemble and replace.
		B Mechanical breakage	
		1) Broken input plate	Disassemble and replace.
		2) Broken shaft or gear	Disassemble and replace.
		3) Damage to the spline	Disassemble and replace.
2	Output drops	A Hydraulic pressure is too low	
		1) Low oil level	Refill oil
		2) Leakage of air from suction line	Check joints and gaskets. Replace as necessary.
		3) Reduced efficiency of gear pump	Disassemble and check. Replace parts as necessary.
		4) Deteriorated spring in inlet port relief valve or malfunction of the piston of piston	Disassemble and check. Replace parts as necessary.
		5) Worn or broken seal ring	
		B Mechanical breakage	Disassemble and replace.
		1) Broken or deformed impeller	
		2) Deformed input plate	Disassemble and replace.
		C Other	Disassemble and replace.
		1) Inappropriate oil (non- specified) is being used.	Change to the specified oil.
3	Abnormal rise in oil temperature	1) Incorrect oil level	Refill or drain oil
		2) Contact of impeller	Disassemble and check. Replace parts as necessary.
		3) Wear or seizure of bearing	Disassemble and check. Replace parts as necessary.
		4) Wear or damaged gear pump	Disassemble and check. Replace parts as necessary.

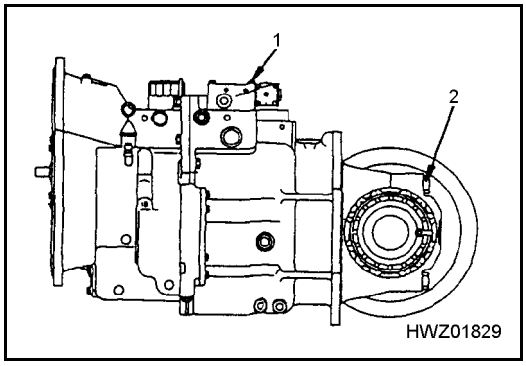
No.	Problem	Cause	Remedy
4	Abnormal noise is generated	1) Cavitation caused by insufficient oil or leakage of air from the suction line	Refill oil or check and replace parts as necessary.
		2) Gear pump at fault	Disassemble and replace parts or assembly
		3) Contact caused by deformed impeller	Disassemble and check and replace parts as necessary
		4) Breakage of input plate	Disassemble and replace.
		5) Breakage of gear	Disassemble and replace.
		6) Wear or breakage of bearings	Disassemble and replace.
		7) Wear of spline	Disassemble and replace.
		8) Loosen bolt	Retighten or replace as necessary.
5	Oil oozes out or leaks	A Oil seal	
		1) Worn or damaged lip	Disassemble and replace.
		2) Dirt caught	Disassemble and check and replace as necessary.
		3) Worn or scratched shaft	Fix or replace.
		4) Hardening or deterioration of rubber because of abnormal rise in oil temperature	Disassemble and replace.
		B O-ring	
		1) Broken O-ring	Disassemble and replace.
		2) Scratched mating surface	Correct or replace.
		3) Hardening or deterioration of rubber because of abnormal rise in oil temperature	Disassemble and replace.
		4) Sudden use in extremely cold weather (below -15°C)	Carry out warming-up operation.
		C Plug, screw	
		1) Loose screw	Retighten.
		2) Broken screw	Replace.
		3) Cracked mating hole	Replace.

TORQFLOW TRANSMISSION - DISASSEMBLY (INDOOR LIFT TRUCK)

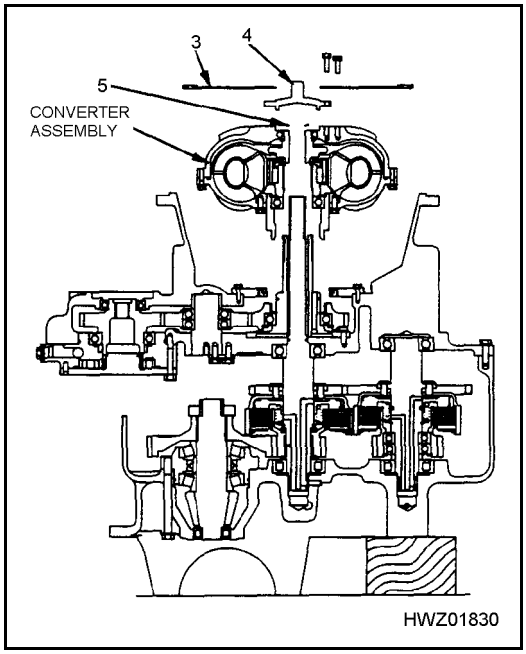
1) Oil drain
   Remove the drain plug and drain oil from the case



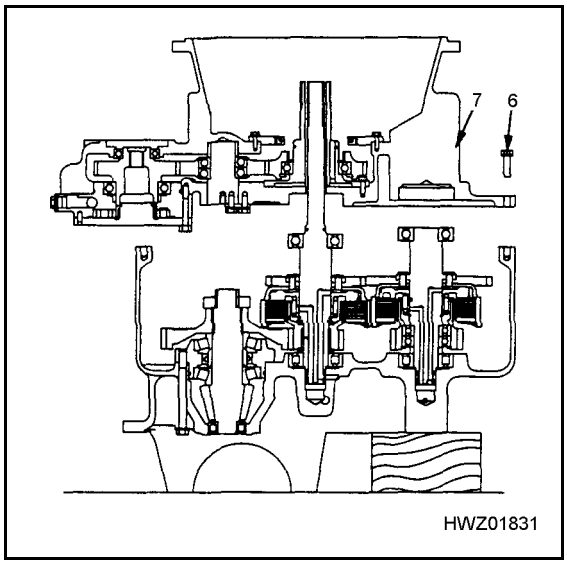
2) Transmission valve, differential
   Unscrew the transmission valve mounting bolt (1) and differential carrier bolt (2) and remove the transmission valve and differential



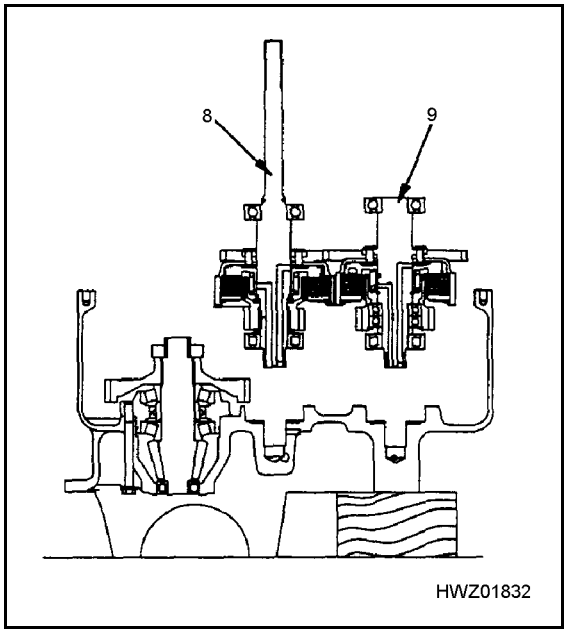
3) Torque converter
   Remove flexible plate (3) and pilot boss (4) and then remove snap ring (5)
   Remove the converter assembly from the turbine shaft



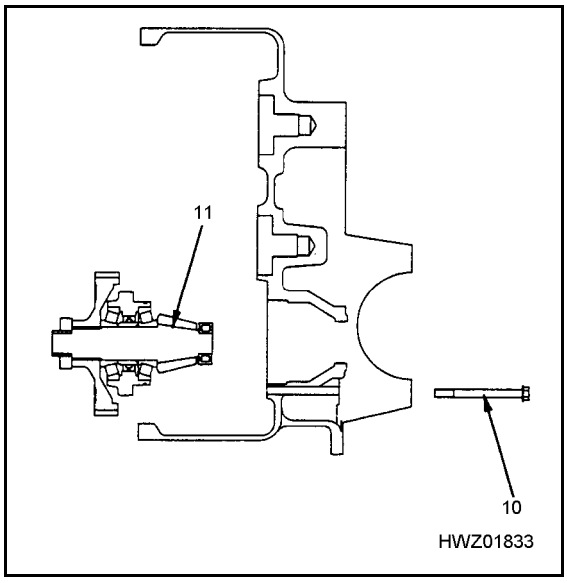
4) Converter case
Unscrew bolt (6) and remove converter case (7)



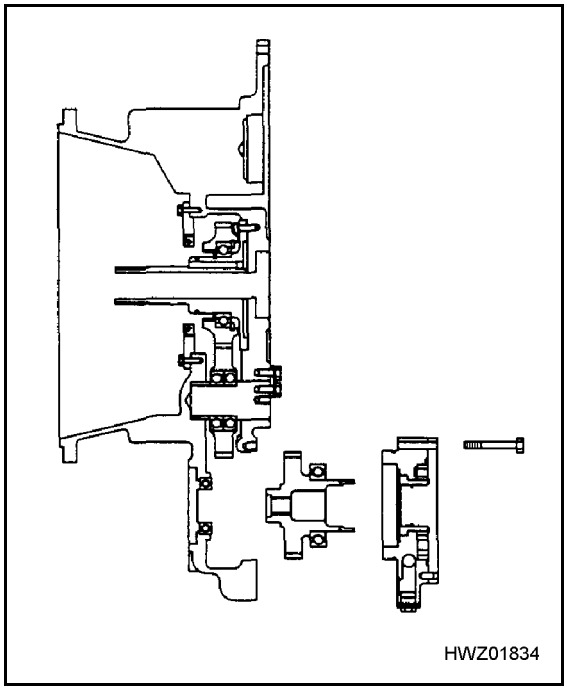
5) Main shafts
Remove the main shafts (8) and (9)



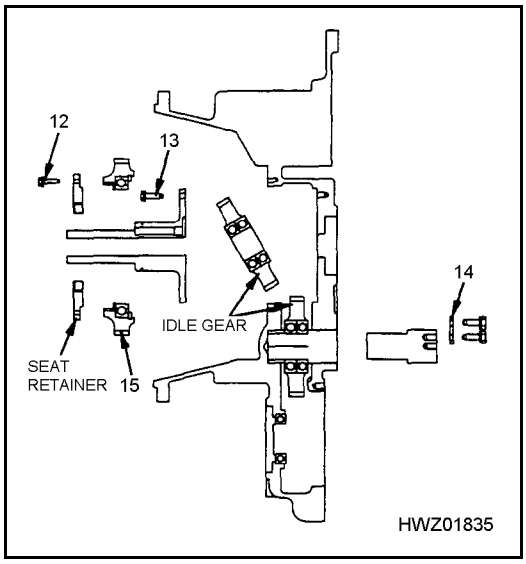
6) Pinion shaft
Unscrew bolt (10) and remove pinion shaft (11)



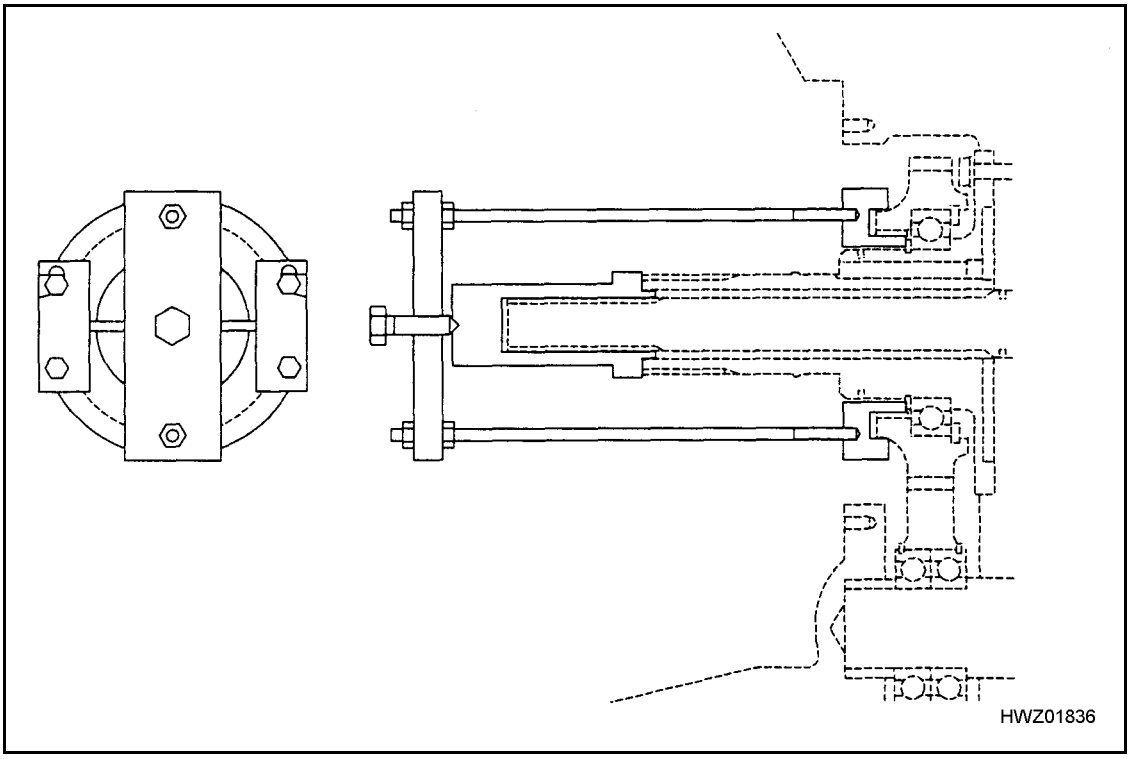
7) PTO driven gear, oil pump assembly
Unscrew the oil pump mounting bolt and remove oil pump and driven gear



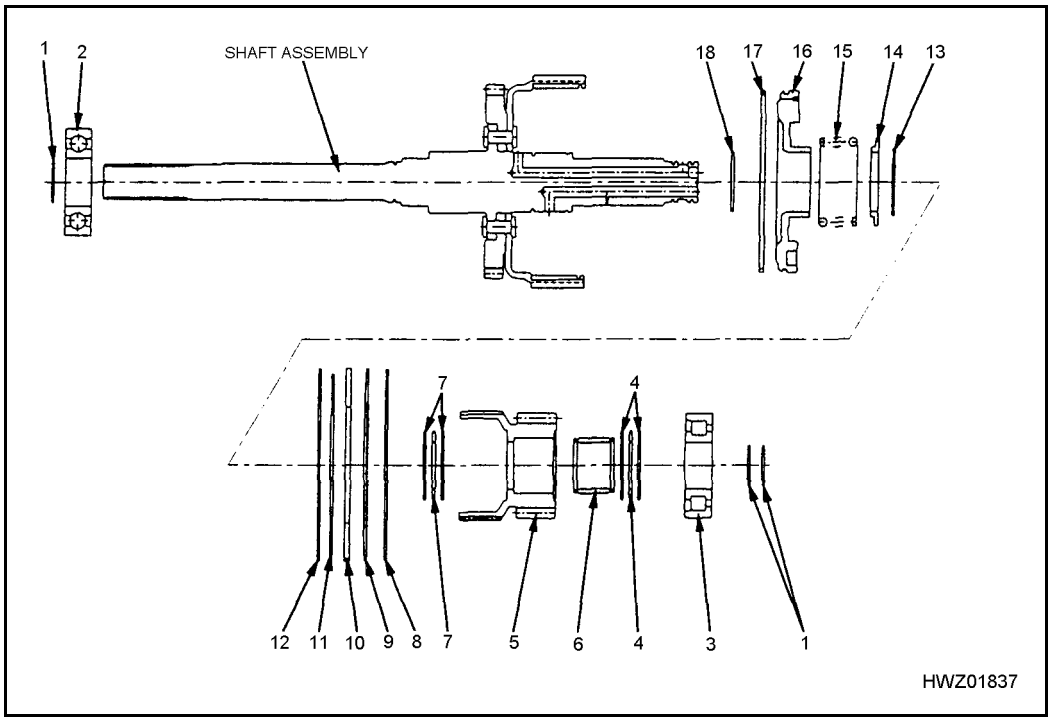
8) Idle gear, stator shaft
Unscrew bolt (12) and remove gear seat retainer and pump boss gear (15)
Unscrew bolt (13) and remove the stator shaft
Remove lock plate (14), idle shaft and idle gear



Pump boss gear removal jig

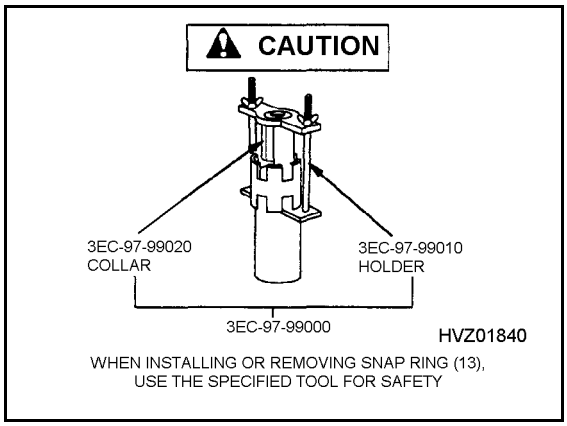


Main shaft A assembly (REV) sub-assembly.
The number indicates the order of disassembly.

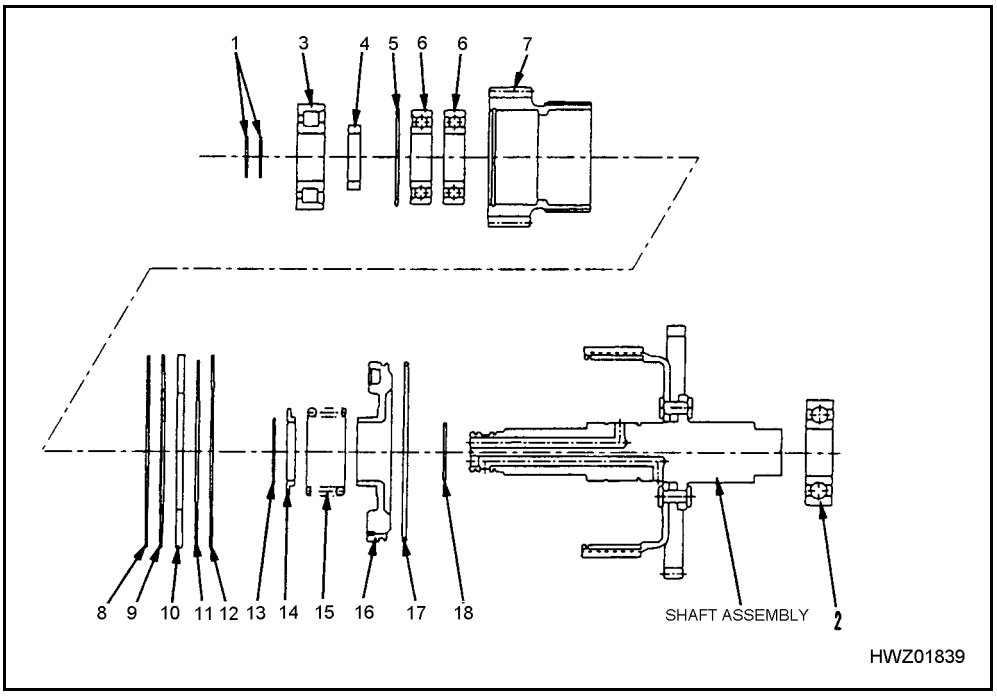


When removing snap ring (13), note that this snap ring is under spring tension. Use special removal tool specified below to avoid injury.

Special tool	3EC-97-99000

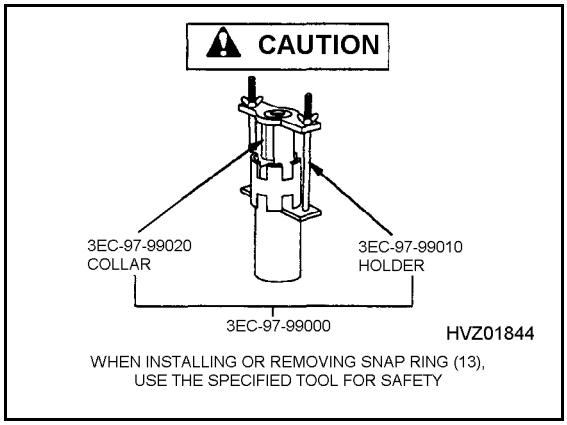


Main shaft B assembly (FWD) sub-assembly.
The number indicates the order of disassembly.

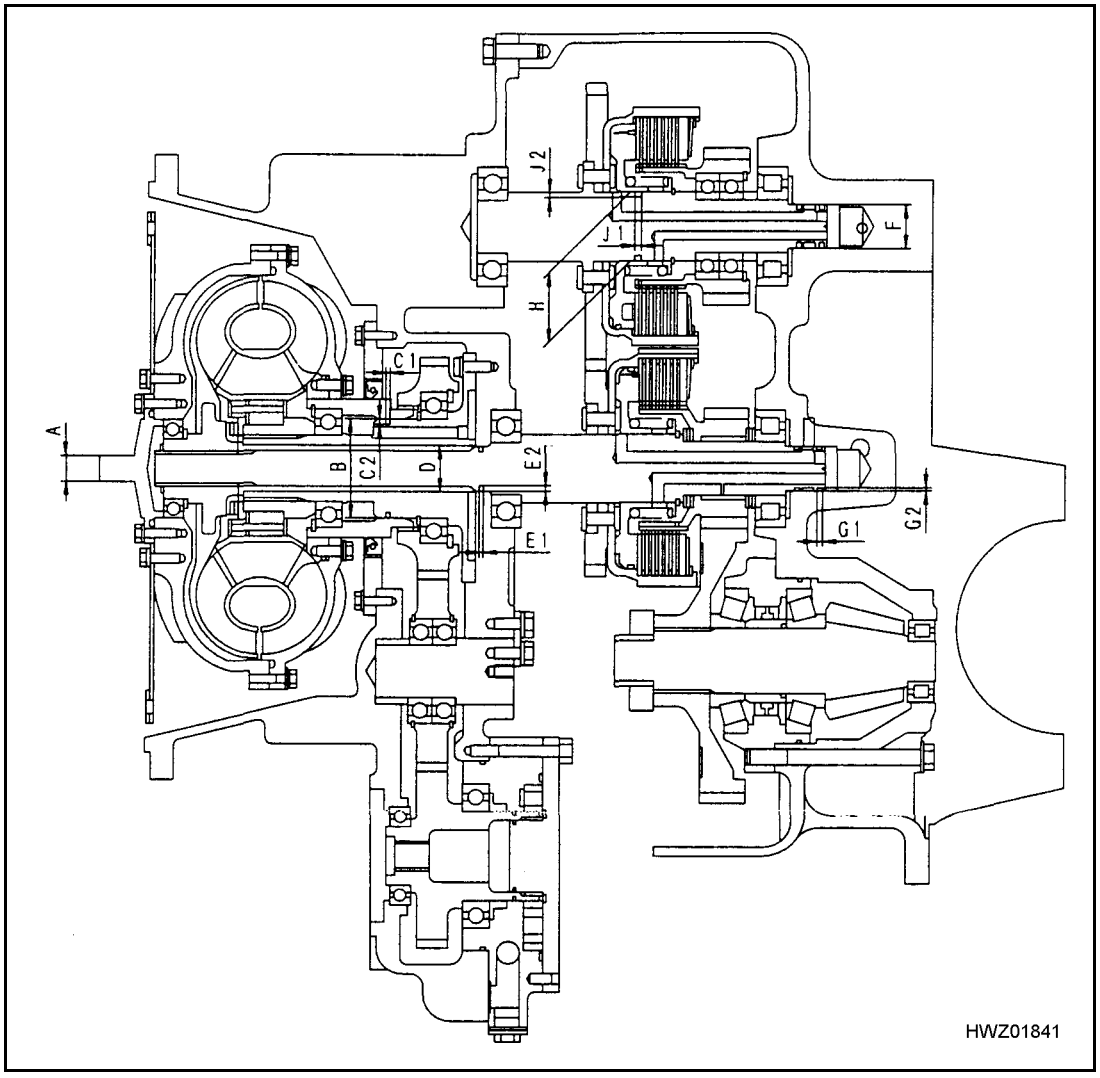


When removing snap ring (13), note that this snap ring is under spring tension. Use special removal tool specified below to avoid injury.

Special tool	3EC-97-99000



SERVICING AND INSPECTION (INDOOR LIFT TRUCK)



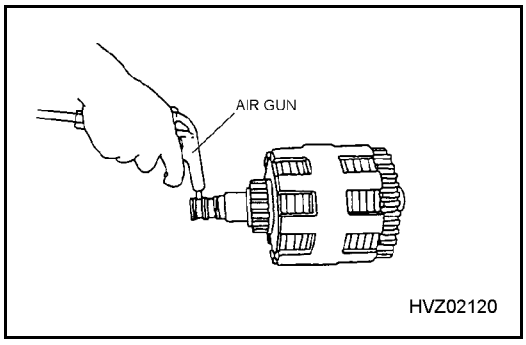
Sym-bol	Check item		Criteria		Remedy
			Standard size (mm)	Standard size (mm)	
A	Pilot tip wear		20	19.85	Replace
B	Pump boss inner diameter (seal ring contact surface)		75	75.15	
C	Seal ring	Width Thickness	3.0 3.3	2.43 2.82	
D	Converter case inner diameter (seal ring contact surface)		35	35.5	
E	Seal ring	Width Thickness	2.0 1.9	1.43 1.42	
F	Transmission inner diameter (seal ring contact surface)		35	35.15	
G	Seal ring	Width Thickness	2.0 1.9	1.43 1.42	
H	Clutch piston inner diameter (seal ring contact surface)		50	50.15	
J	Seal ring	Width Thickness	2.5 2.0	1.93 1.52	

INSTRUCTIONS IN ASSEMBLING (INDOOR LIFT TRUCK)

1) Cleaning parts
   A) Prior to assembling, thoroughly clean the case bolt holes (and threads) and oil groove corners
   B) Thoroughly clean the threads of the case vertical hole bolts, in particular, because dirty threads may result in incorrect tightening torque or broken bolts. Remove all residual Loctite and debris from threads.

2) Clutch pack assembly
   Blow the oil hole with compressed air and check operation of drive plate and driven plate.

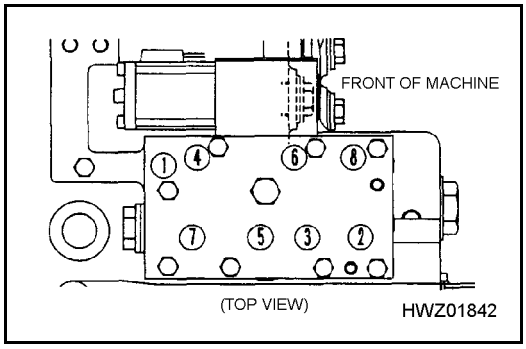
Air pressure	5 kg/cm^2 (71 psi)
Stroke	F1/R1: 2mm (.079 in.)
Stroke	F2: 1.7mm (.067 in.)



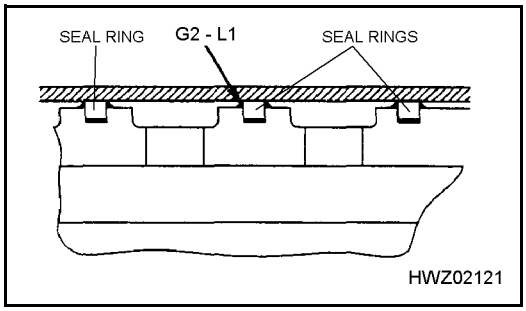
3) Control valve
   A) Tighten mounting bolts in sequence as shown in the Figure at right.

Torque	27 - 34 Nm (2.8 - 3.5 kgfm) (20 - 25 psi)

   B) After assembling, check operation of the spool.
   Insufficient tightening: Oil leakage
   Excessive tightening: Malfunction



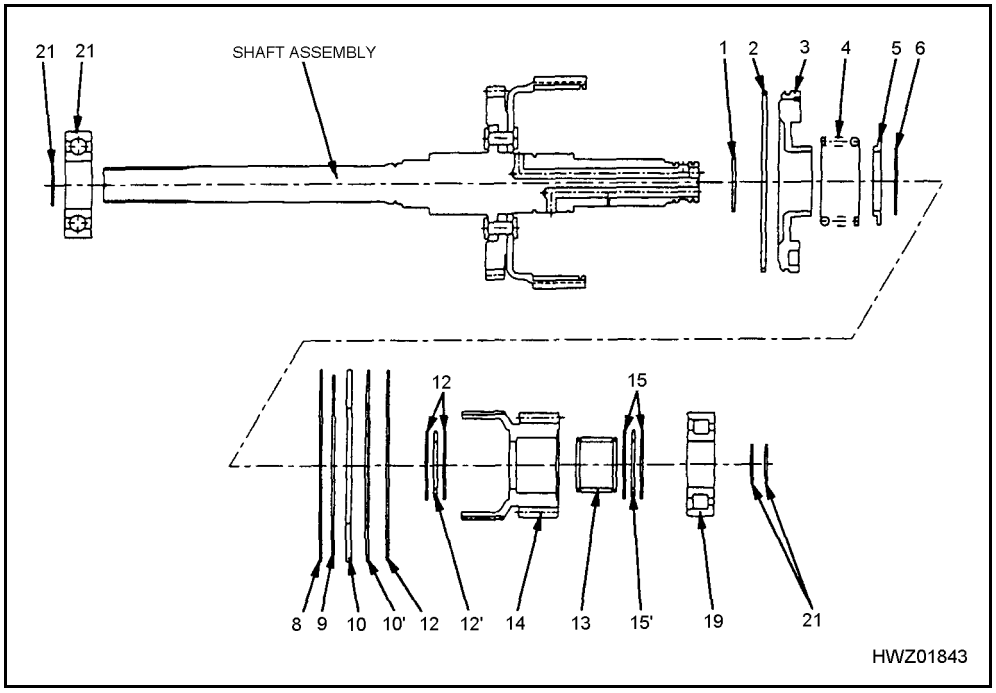
4) Seal ring
   Apply grease to the seal ring while assembling



ASSEMBLING MAIN SHAFT A ASSEMBLY (REV) SUB-ASSEMBLY (INDOOR LIFT TRUCK)

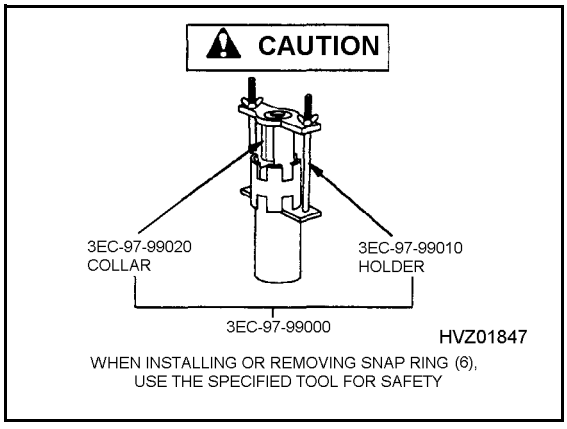
NOTE: Dip the clutch plate and disc in oil before assembling them.

NOTE: Apply grease to the seal ring. The numbers in the Figure indicate the order of assembly.

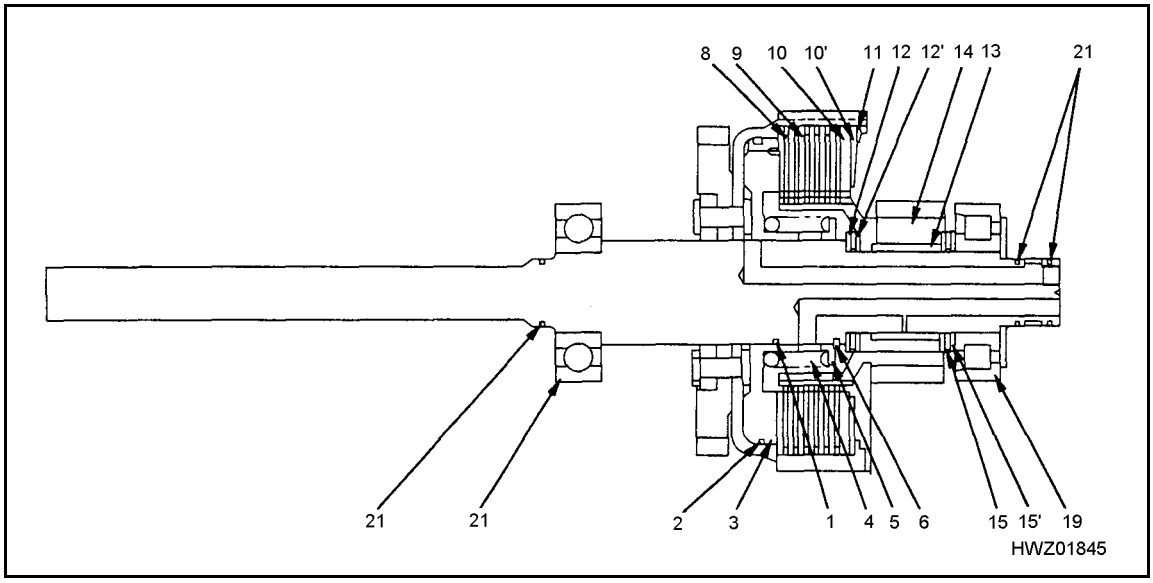


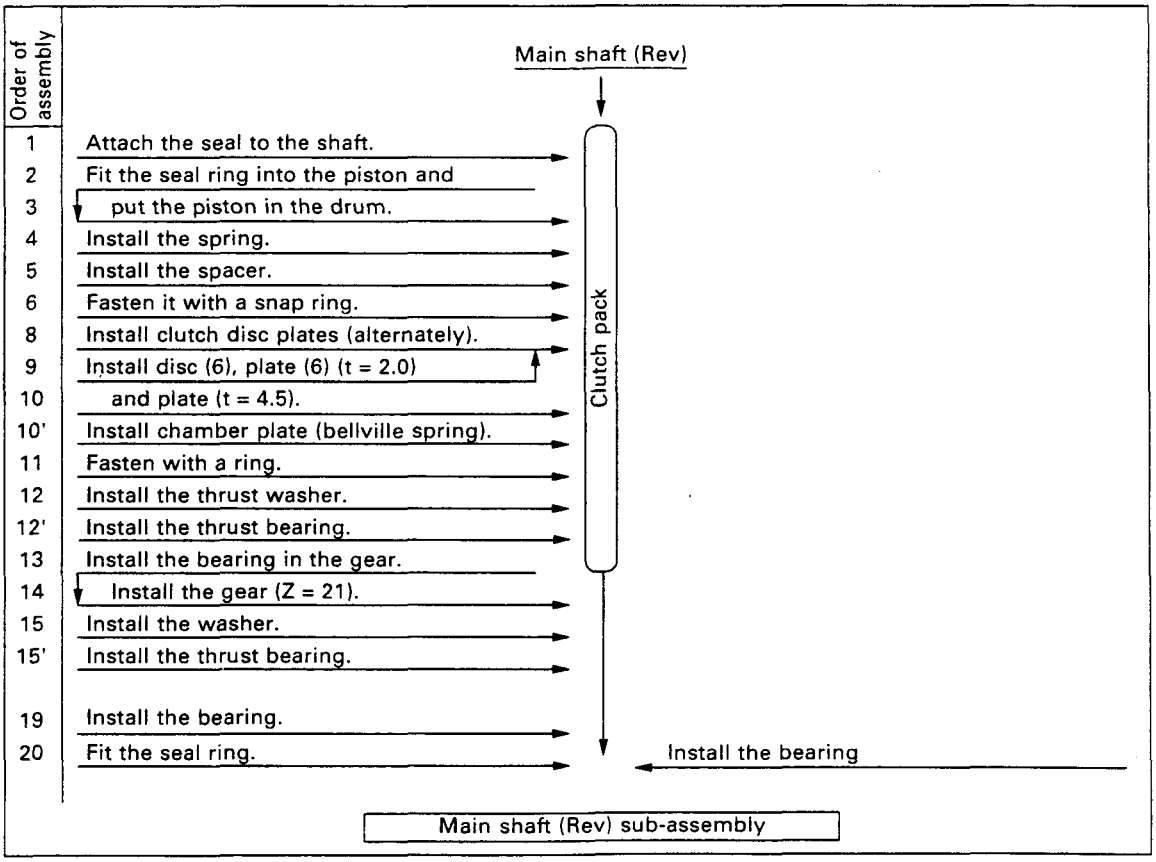
When installing snap ring (6), be aware that it is under spring tension. Use specified snap ring tool to avoid injury.

Snap ring tool	3EC-97-99000



ASSEMBLY FLOW CHART OF MAIN SHAFT (REV) ASSEMBLY

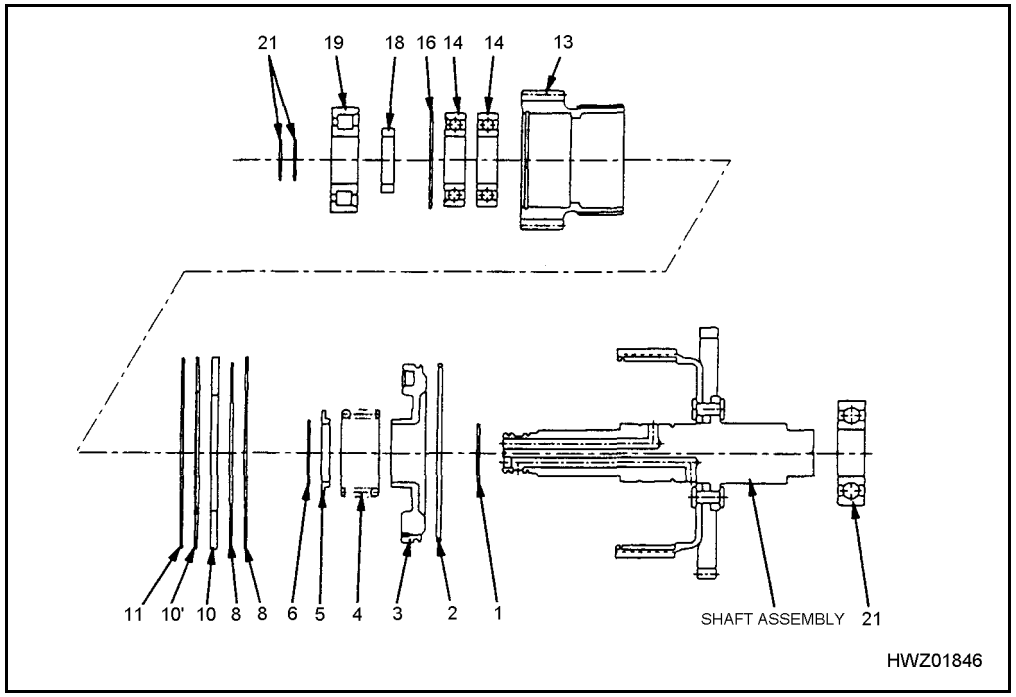




ASSEMBLING MAIN SHAFT B ASSEMBLY (FWD) SUB-ASSEMBLY (INDOOR LIFT TRUCK)

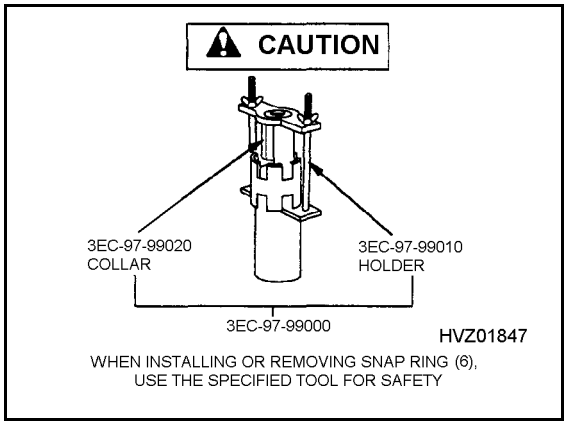
The numbers in the Figure indicate the order of assembly

NOTE: Dip the clutch plate and disc in oil before assembling them.
NOTE: Apply grease to the seal ring.

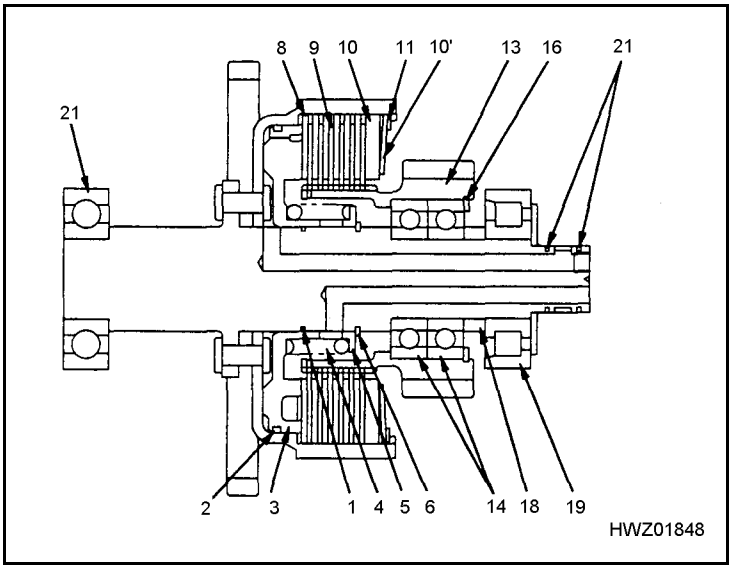


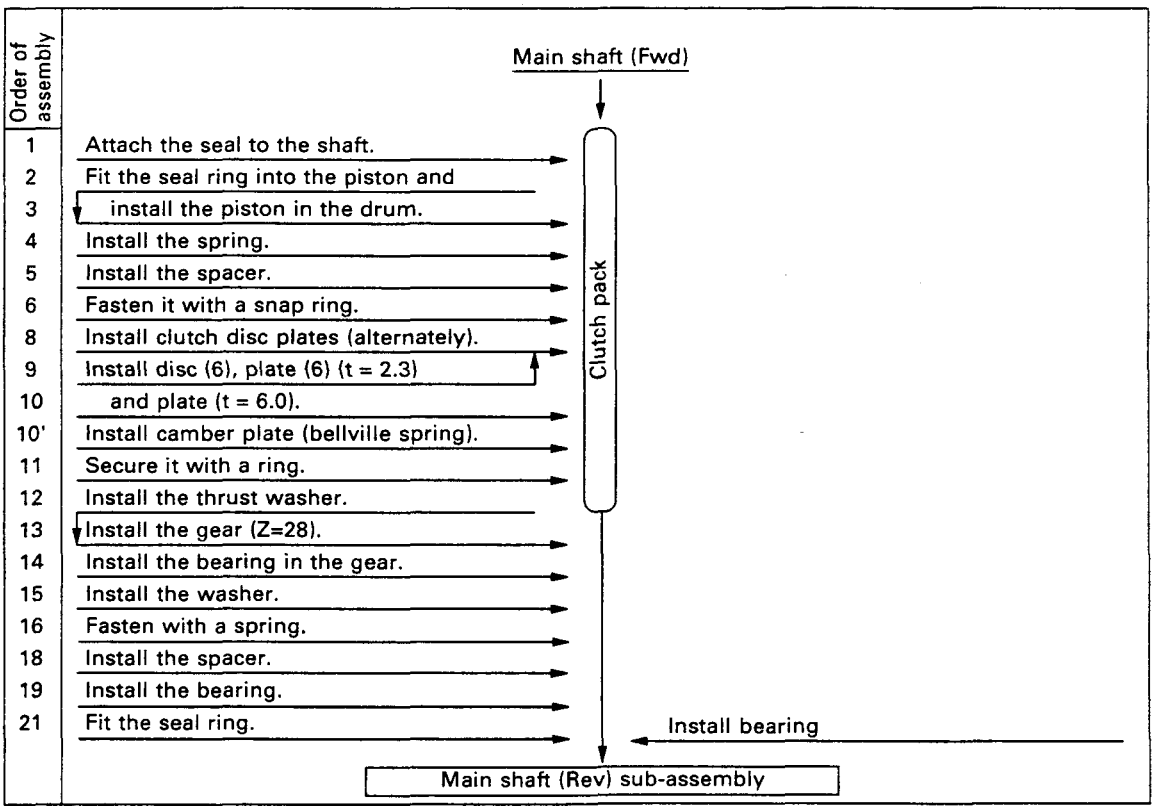
When installing snap ring (6), be aware that it is under spring tension. Use specified snap ring tool to avoid injury.

Snap ring tool	3EC-97-99000

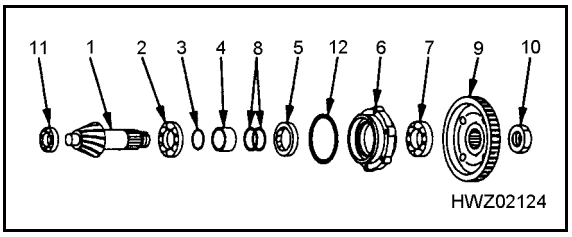


ASSEMBLY FLOW CHART OF MAIN SHAFT (FWD) ASSEMBLY (INDOOR LIFT TRUCK)



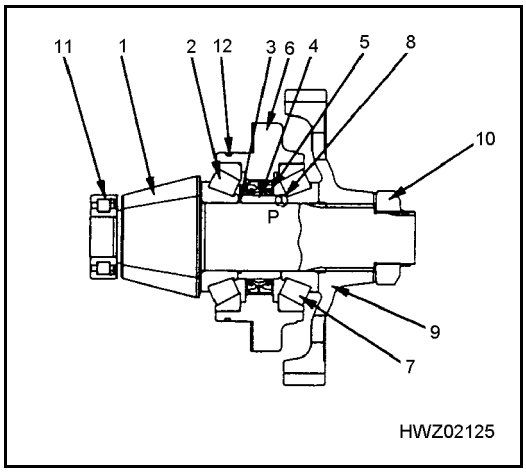


ASSEMBLING OUTPUT SHAFT SUB-ASSEMBLY
(Assemble in the reverse order of disassembly)

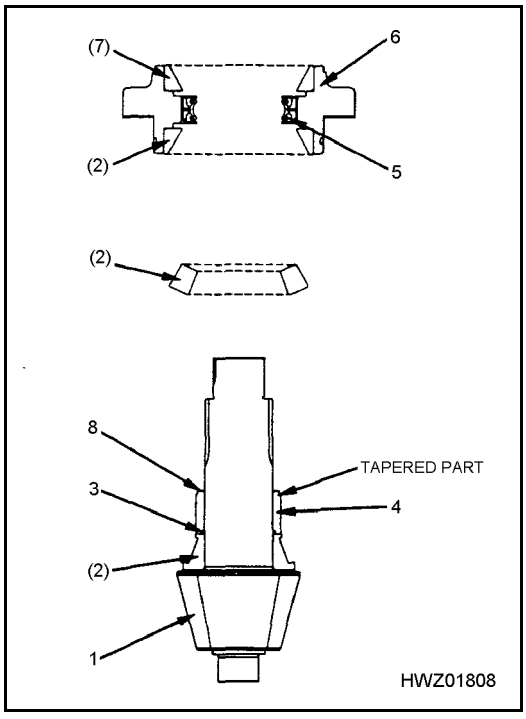


1) Attach the inner race of bearing (1) to pinion shaft (1)

2) Fit O-ring (3) into the inner race of bearing (2) by pressing the ring down on the race to install race (4)
   NOTE: The tapered part of race (4) should face the spline splined side.



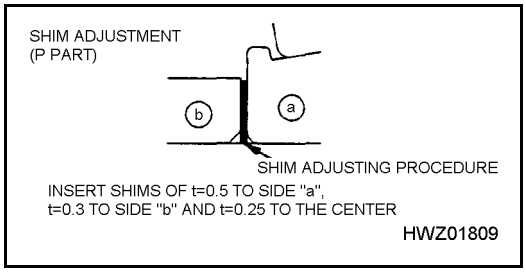
3) Attach oil seal (5) to cage (6) and install the outer races of bearings (2) and (7) on both sides of the cage.
   NOTE: Fit the seal in such a way that the rounded side on the back faces the pinion.
   NOTE: After fitting the seal, apply lithium grease to the lip.



4) Install shim (8)
   NOTE: Refer to the thickness of the disassembled shims.
   NOTE: See “Shim Adjustment” at right

5) Fit the roller of bearing (2) into the inner race installed on pinion shaft (1)

6) Install cage (6) (with oil seal (6) and outer races of bearings (2) and (7) assembled), on pinion shaft.



7) Fit the roller of bearing (7) into the outer race of cage (6).

8) Install the inner race of bearing (7).
NOTE: Before installing the inner race, ensure that the adjustment shim has been installed.

9) Install gear (9) (Z = 53)

10) Install and tighten nut (10)

Torque	314 - 441 Nm (32 - 45 kgfm) (231.6 - 325.3 lbft)

NOTE: After tightening nut (10) to the specified torque, check that the starting torque is within the following range:

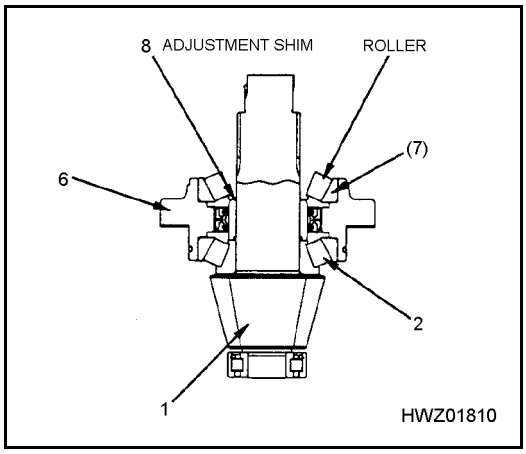
Starting torque	4 - 9 Nm (40 - 80 kgfm) (2.9 - 6.6 lbft)

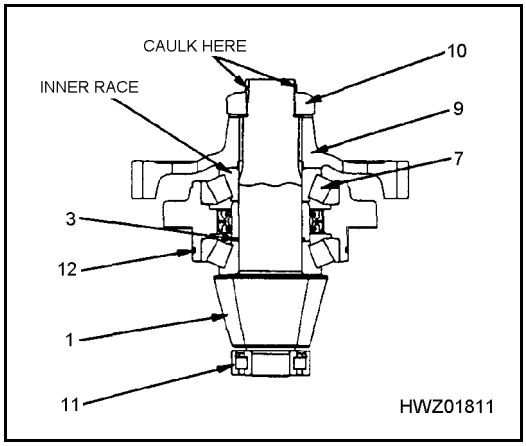
If the starting torque does not fall within the specified range, adjust shim (8) again to obtain the correct value.

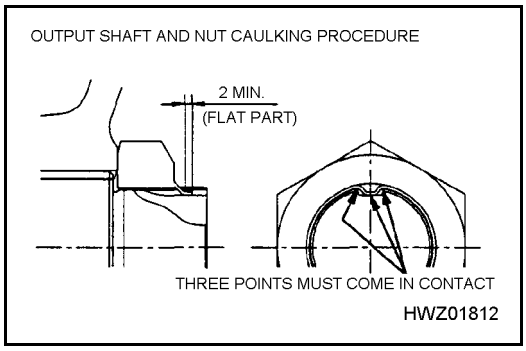
11) After adjusting the starting torque of the pinion shaft, caulk nut (10).

12) Install bearing (11) and caulk
Caulk three points on the circumference (at equal intervals) using a punch so that they come into contact with the bearing inner race scale.

13) Fit O-ring (12) into the ring groove of cage (6).





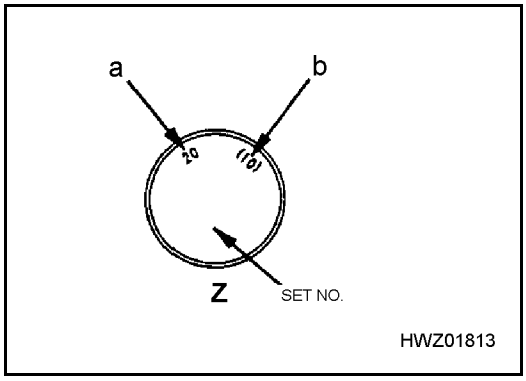


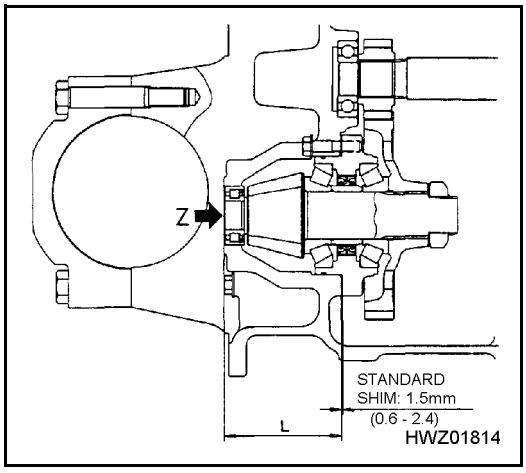
ADJUSTING OUTPUT SHAFT SUB-ASSEMBLY (PINION SHAFT PROTRUSION) (INDOOR LIFT TRUCK)

1) Shim between the cage and the transmission. Calculate the thickness, using the following formula to obtain pinion shaft protrusion (Standard shim is 1.2mm)

Shim thickness T = 0.30 + $\frac{a = b = c = d}{100}$

- a and b: Read the numbers on the pinion shaft end.
  After adjusting the starting torque of the output shaft sub-assembly, adjust the protrusion, using the shim.
- c: Value expressing the difference against the standard length of 120.82mm in 1/100 units after measuring length L.
- d: Read the value stamped on the transmission case on the end that houses the pinion shaft end bearing. (Example: 25)

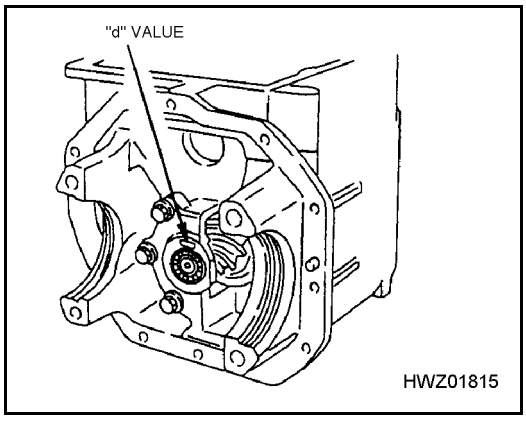




2) Example of shim calculation
   a = 20 (Value stamped on the pinion)
   b = 10 (Value stamped on the pinion)
   Calculate as follows:
   c = (L - 120.82) x 100 = (121.39 - 120.82 x 100)
   = 57 (e.g.: L = 121.39)
   d = 25 (Value stamped on transmission case)

Shim thickness T = 0.3 + $\frac{20 + 10 + 57 + 25}{100}$

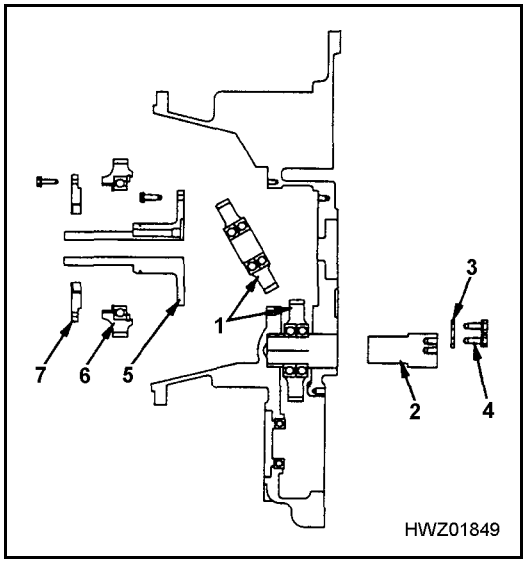
= 1.42mm



ASSEMBLY

1) Idle gear and stator shaft
   A) Set idle gear (1) in the case and install idle shaft (2)
   B) Fasten idle shaft to case with lock plate (3) and bolts (4)
      Use following bolts:
      M10 x 1.5 Length from neck 20mm

Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)



   C) Install stator shaft (5) in the case
   D) Fasten with a bolt
      Use following bolt:
      M8 x 1.25 Length from neck 22mm

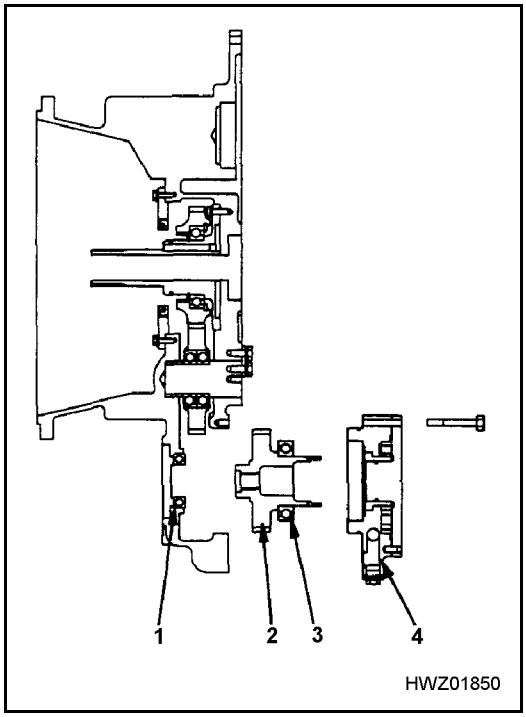
Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)

   E) Install pump boss gear (5) on the stator shaft and fit the snap ring
   F) Install seat retainer in the case
   G) Fasten with a bolt
      Use following bolt:
      M8 x 1.25 Length from neck 22mm

Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)

2) PTO driven gear and oil pump assembly
   A) Assemble bearing (1)
   B) Engage driven gear (2) with the idle gear and install them
   C) Assemble bearing (3)
   D) Assemble oil pump assembly (4)
   E) Fasten with a bolt
      Use following bolt:
      M8 x 1.25 Length from neck 70mm

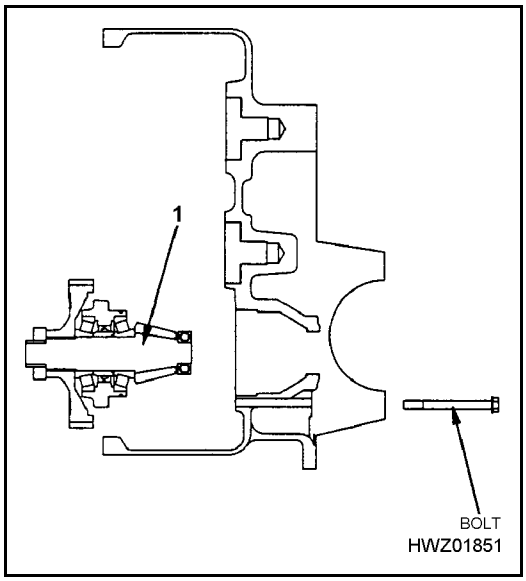
Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)



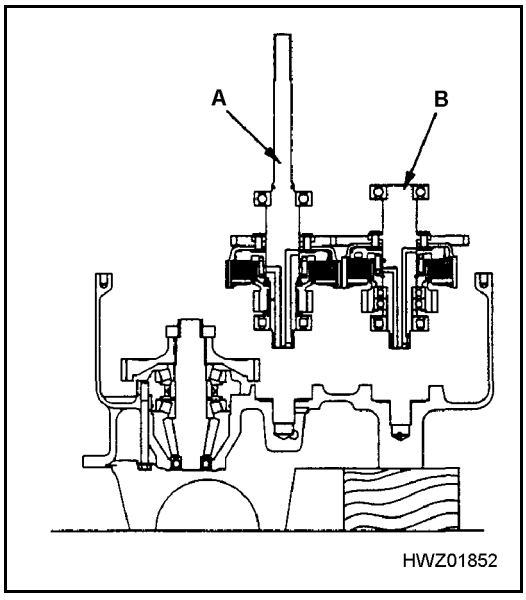
3) Pinion shaft assembly
   A) Assemble pinion shaft assembly (1) in the case
   B) Fasten with bolts
      Use the following bolts:
      M12 x 1.75 Length from neck 50mm
      M12 x 1.75 Length from neck 130mm

Torque	98.1 - 122.6 Nm (10.0 - 12.5 kgfm) (72.4 - 90.4 lbft)

Apply Loctite #572 to the internal threads

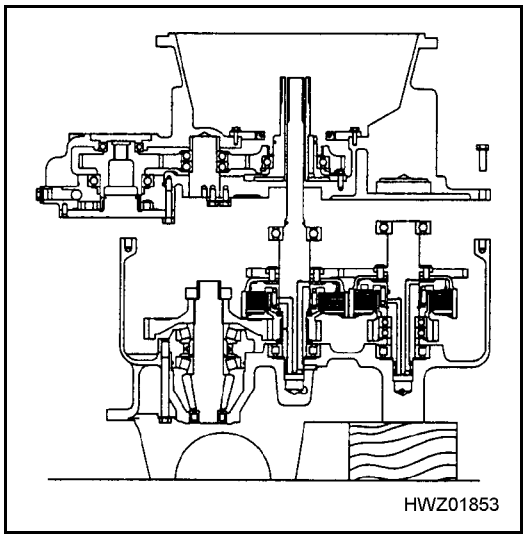


4) Main shaft assembly
   Set the direction as shown in the figure on the right, using a piece of wood as a support
   A) Assemble main shaft assembly (A)
   B) Assemble main shaft assembly (B)



5) Assembling torque converter housing and transmission case
   A) Assemble the torque converter housing with the transmission case
   B) Fasten with bolts
      Use the following bolts:
      M10 x 1.5 Length from neck 3mm

Torque	35.3 - 44.1 Nm (3.6 - 5.5 kgfm) (26.0 - 32.5 lbft)

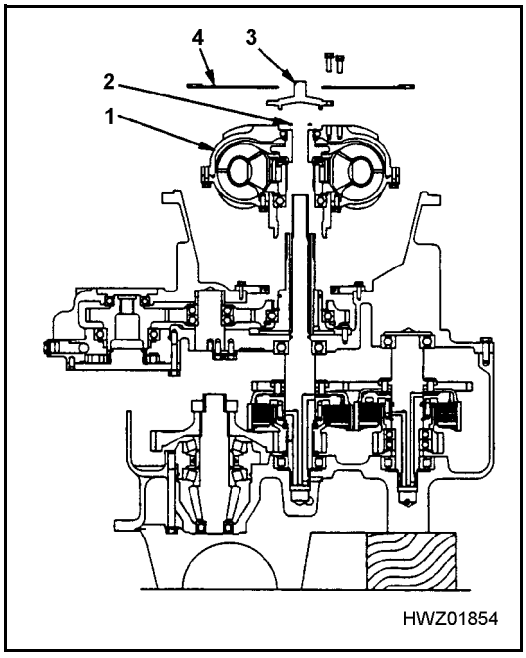


6) Torque converter assembly
   A) Align torque converter assembly (1) with the stator shaft and turbine shaft spline and join them
   B) Install snap ring (2)
   C) Install pilot boss (3)
      Use the following bolts:
      M8 x 1.25 Length from neck 22mm

Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)

   D) Install flexible plate assembly (4)
      Use the following bolts:
      M8 x 1.25 Length from neck 22mm

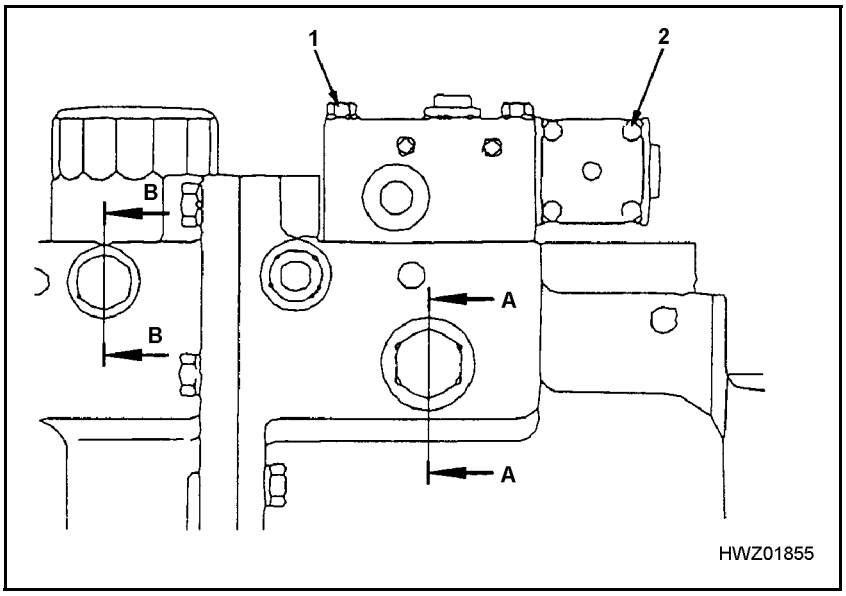
Torque	18.6 - 24.5 Nm (1.9 - 2.5 kgfm) (13.7 - 18.1 lbft)



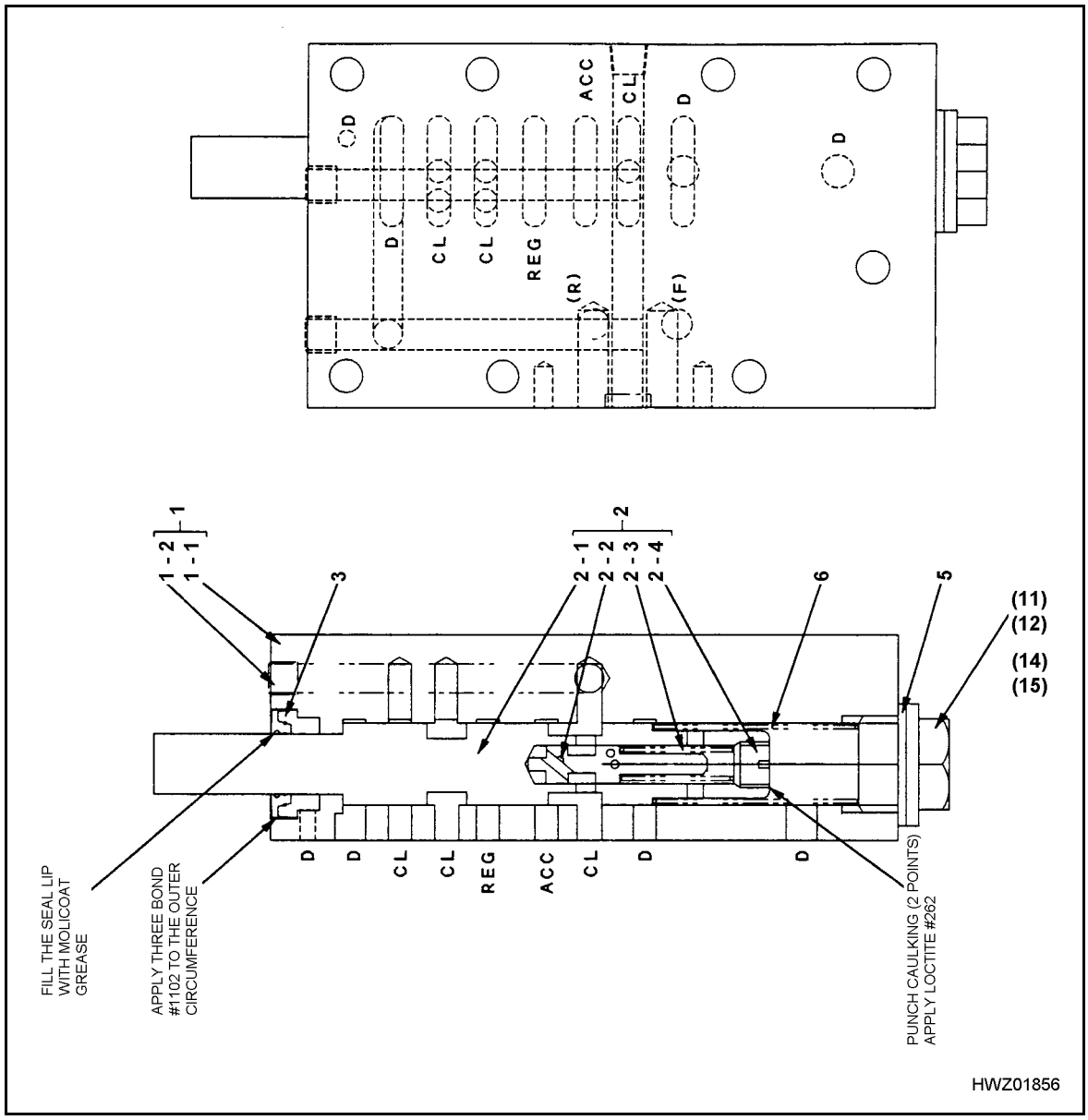
TRANSMISSION CONTROL VALVE

DISASSEMBLING CONTROL VALVE

1) Remove bolt (1) to remove the control valve from the transmission and remove bolt (2) that fastens the solenoid valve to the valve body. Then remove the solenoid valve. Use a 4mm hex wrench.



2) Pull the inching spool, valves and pistons out of the valve body. Keep removed parts in order so that they can be reassembled in proper sequence.

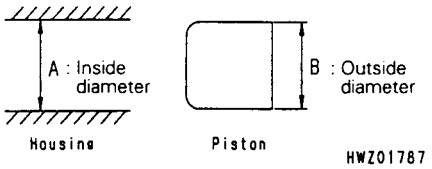
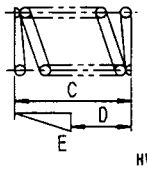


No.	Name	Q'ty	No.	Name	Q'ty
1	Valve body assembly	1 ass'y	2 - 3	Spring	1
1 - 1	Valve body	1	2 - 4	Plug	1
1 - 2	Plug	3	3	Oil seal	1
2	Plug	1	4	Plug	1
2	Inching valve assembly	1	5	Seal washer	1
2 - 1	Inching valve	1	6	Return spring	1
2 - 2	Inching regulator valve	1	--	----------	--

TROUBLESHOOTING

No.	Problem	Cause	Remedy
1	Power is not transmitted	No hydraulic pressure	
		1) Broken piston in the inlet relief valve or regulator valve or broken spring	Disassemble and replace.
		2) Stuck solenoid valve	Disassemble and replace.
2	Output drops	Hydraulic pressure is too low	
		1) Deteriorated spring in inlet port relief valve or regulator valve or malfunction of piston	Disassemble and check. Replace parts as necessary.
		2) Stuck solenoid valve	Disassemble and replace.
		3) Operation of inching valve	Make adjustment.
3	Oil oozes out or leaks	Surface of joint with gasket included	
		1) Loosening of bolts	Retighten.
		2) Broken gasket	Disassemble and replace.
		3) Scratched mating surface	Correct or replace.
4	Electromagnetic valve does not function	No voltage	
		1) Defective forward/reverse gear shift lever switch	Check and repair or replace.
		2) Connector fails to make contact	Check and repair.
		3) Fused or disconnected fuse or wiring circuit	Check and repair or replace.
		Presence of voltage	
		1) Disconnected grounding circuit	Check and repair.
		2) Connector fails to make contact	Check and repair.
		3) Frame grounding wire fails to make contact	Check and repair.
		4) Stuck solenoid valve	Check and repair or replace.
		5) Disconnected solenoid or wiring circuit	Check and repair or replace.

MAINTENANCE STANDARD

No.	Check item		Criteria		Remedy
			Standard size (mm)	Allowable limit (mm)	
	Piston or spool and body hole  				
	Accumulator	Outside diameter of piston Inside diameter of body Clearance	31.95 – 31.975 32.0 – 32.025 0.025 – 0.075	 0.07	Replace
	Regulator	Outside diameter of piston Inside diameter of body Clearance	11.973 – 11.984 12.0 – 12.011 0.016 – 0.038	 0.07	
	Inching regulator	Outside diameter of spool Inside diameter of body Clearance	9.986 – 9.995 10.0 – 10.015 0.005 – 0.029	 0.05	
	Inching spool	Outside diameter of spool Inside diameter of body Clearance	21.967 – 21.98 22.0 – 22.021 0.102 – 0.054	 0.07	
	Spring  C: Free length D: Installed length E: Installed load				
	Large spring of accumulator	Free length	153.5	138	
	Small spring	Free length	150	135	Replace
	Large spring of regulator	Free length	148	133	
	Small spring	Free length	108	97	
	Inching spool (Large spring)	Free length	78	70	
	Small spring (Inching regulator)	Free length	28	25	

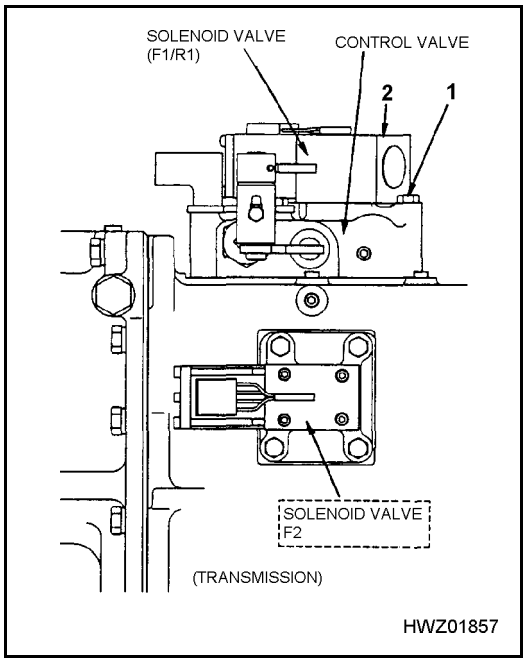
TRANSMISSION CONTROL VALVE (OUTDOOR LIFT TRUCK)

DISASSEMBLY OF CONTROL VALVE

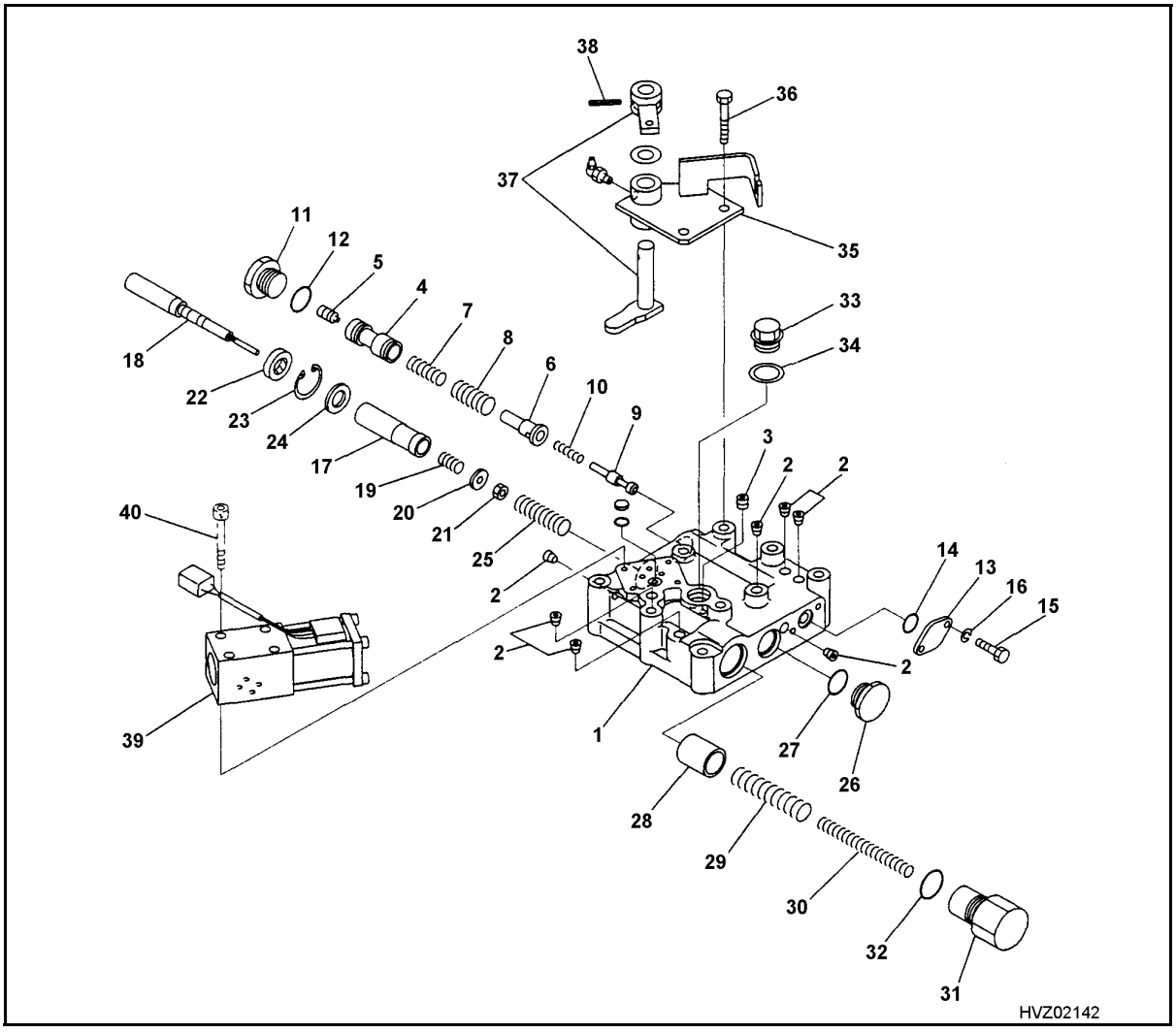
1) Remove bolt (1) to remove the control valve from the transmission and remove bolt (2) that attaches the solenoid valve. Remove the solenoid valve from the valve body.
   Use a 4mm hex wrench.

NOTE: The F2 solenoid valve on the F2/F1 lift truck is mounted on the right side of the transmission case.
Remove the bolt that attaches the cover.
Then remove the cover and gasket.

2) Pull out the inching spool, valves and pistons from the valve body. Keep all removed parts in order so that they can be assembled in the reverse order of disassembly.

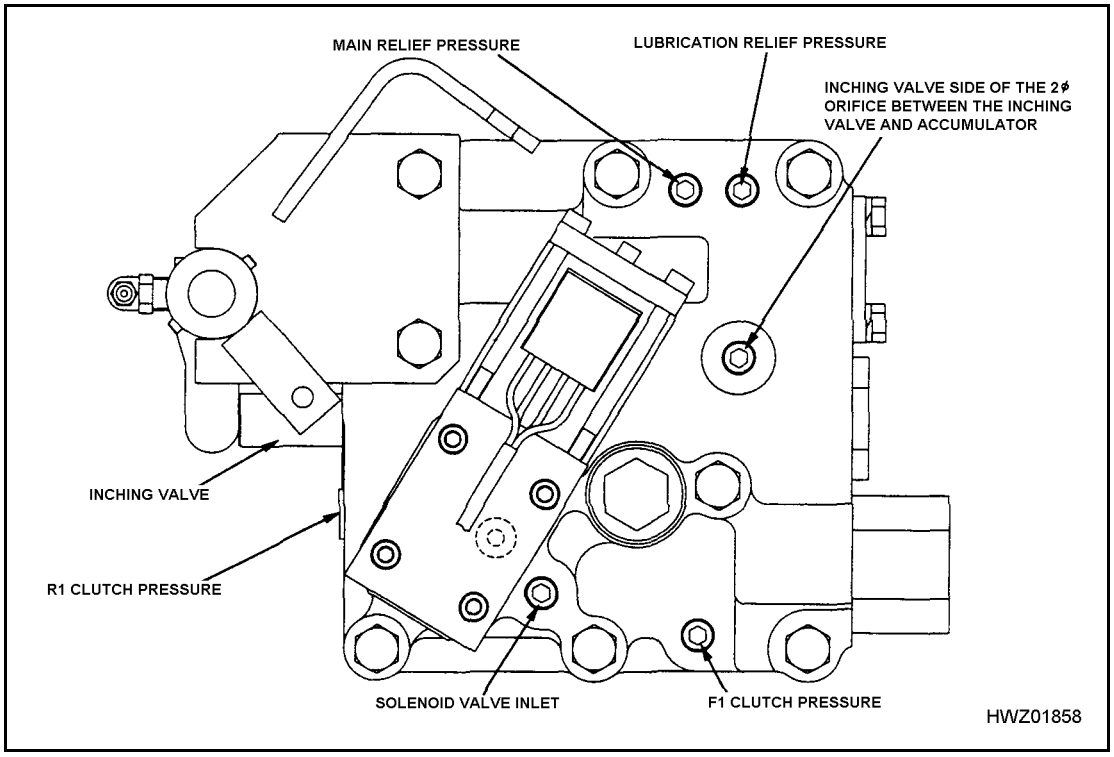


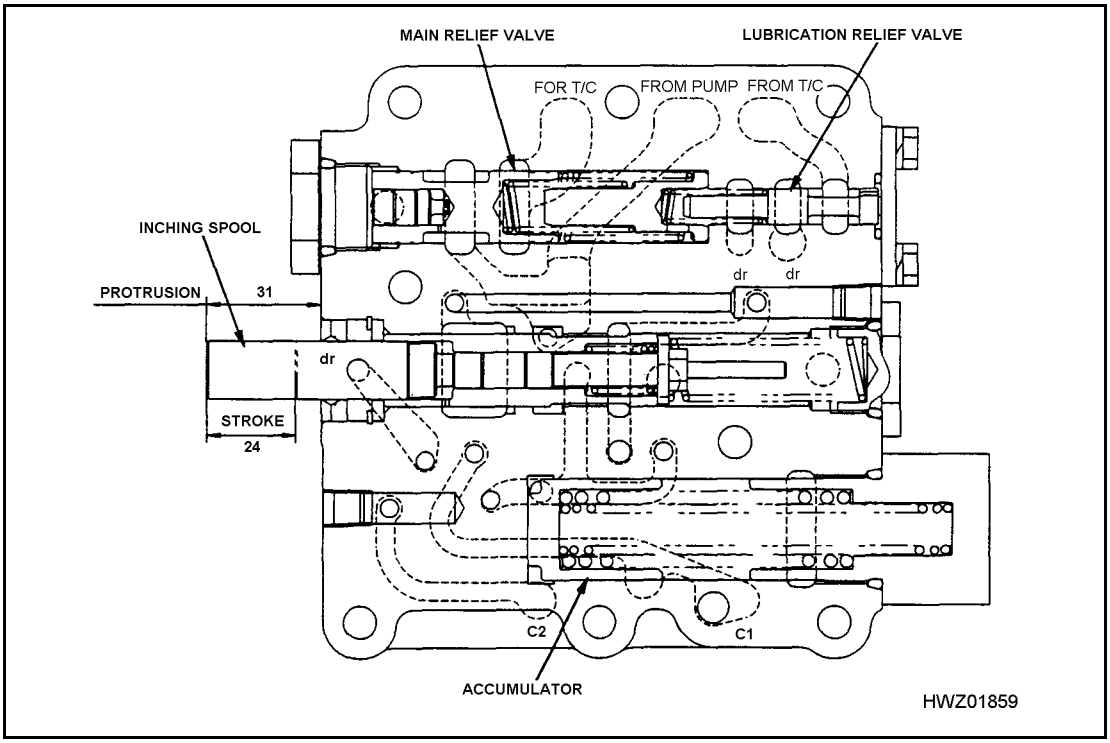
COMPONENT PARTS



No.	Name	No.	Name	No.	Name
1	Valve body	15	Bolt	29	Spring (L = 83)
2	Plug	16	Spring washer	30	Spring (L = 107)
3	Screw	17	Inching valve	31	Plug
4	Regulator valve (relief)	18	Inching spool	32	O-ring
5	Piston	19	Spring (L = 27)	33	Plug
6	Stopper	20	Stopper	34	Gasket
7	Spring (L = 55.5)	21	Nut	35	Bracket
8	Spring (L = 73.8)	22	Seal	36	Bolt
9	Lubrication relief valve	23	Snap ring	37	Inching lever
10	Spring (L = 33.8)	24	Plate	38	Pin
11	Plug	25	Spring (L = 74)	39	Solenoid valve
12	O-ring	26	Plug	40	Bolt
13	Plate	27	O-ring		
14	O-ring	28	Piston (accumulator)		

ASSEMBLY DRAWING



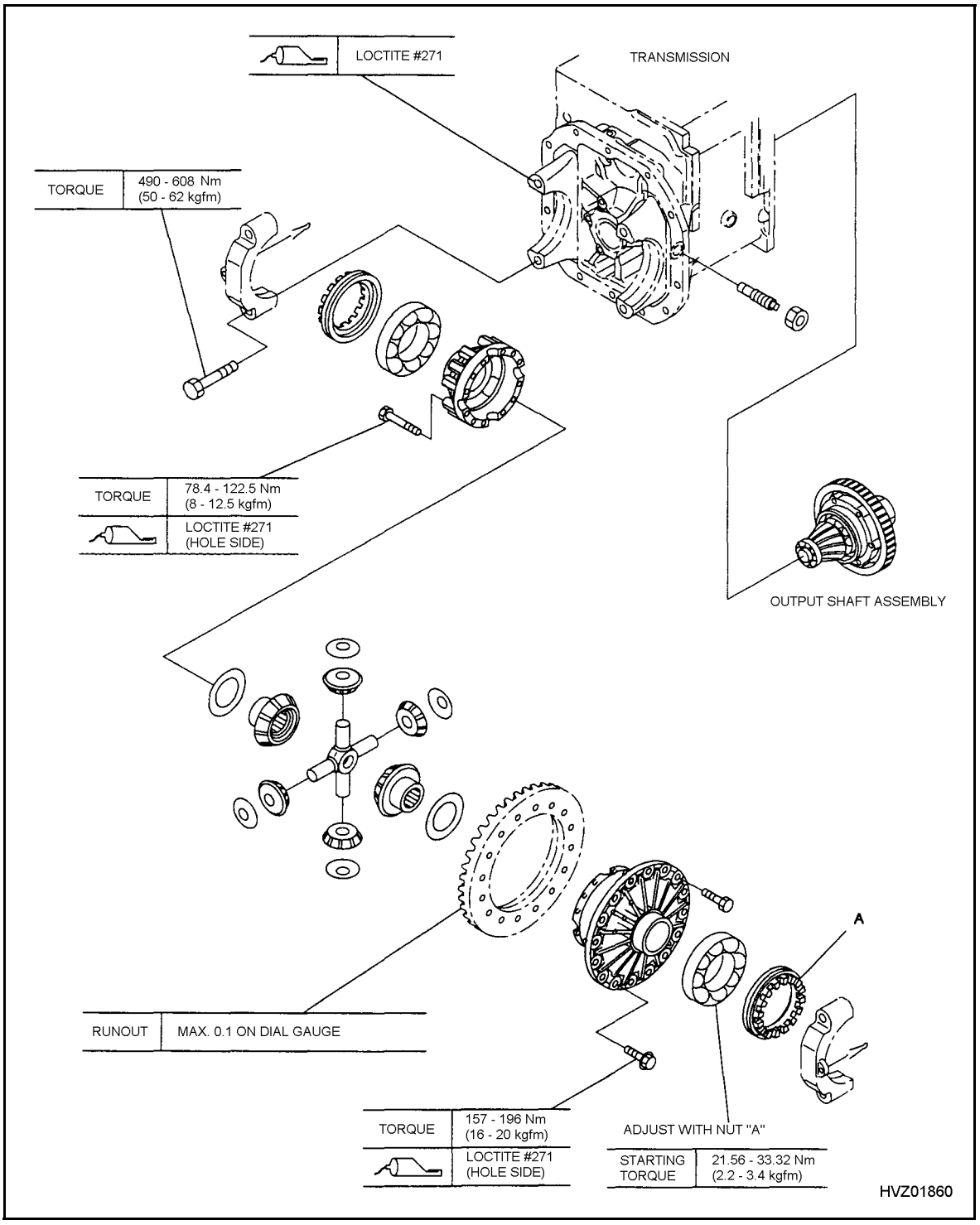


TROUBLESHOOTING

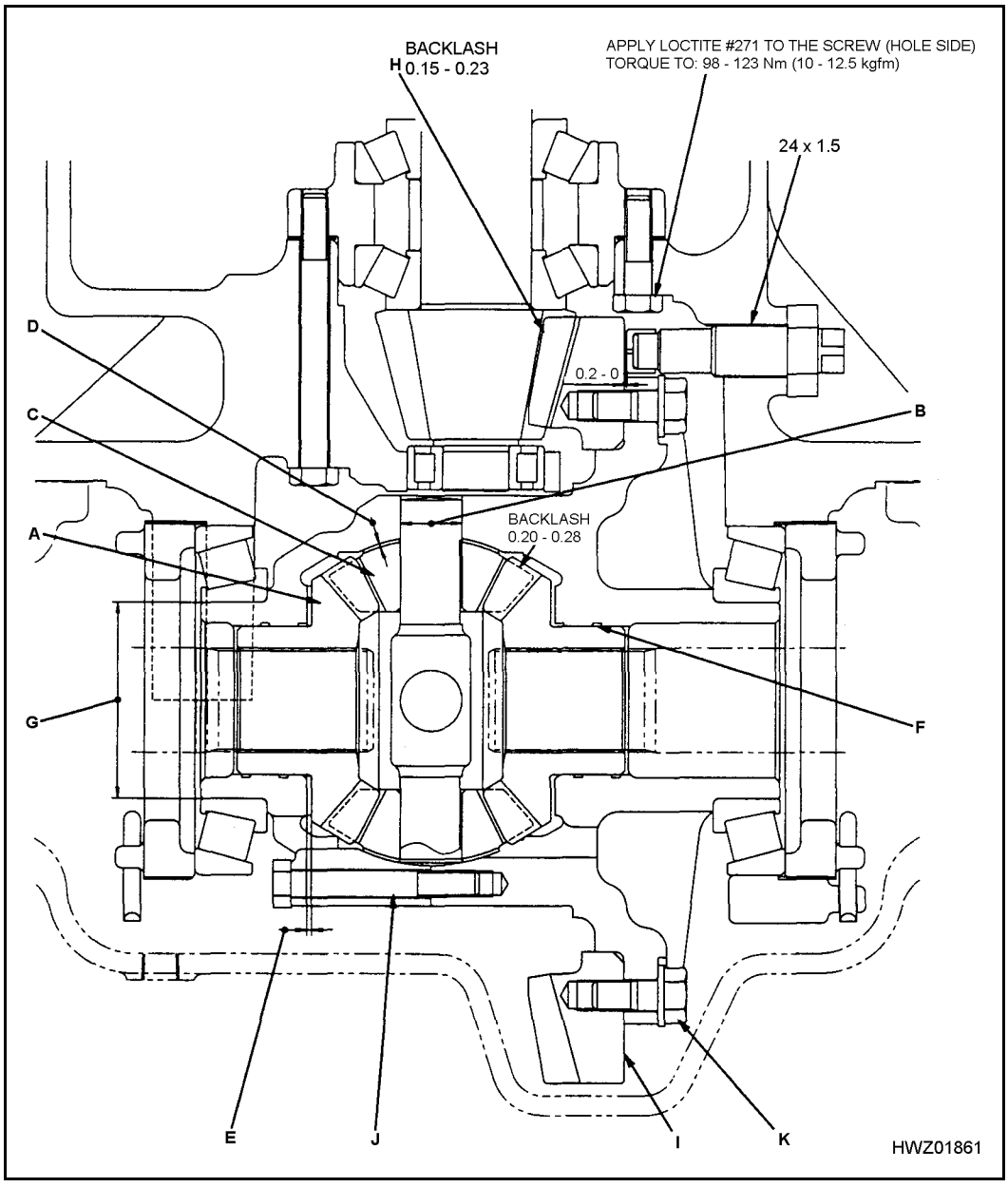
No.	Failure	Cause	Remedy
1	Power is not transmitted.	No oil pressure. 1) Broken piston or spring of the inlet relief or regulator valve. 2) Stuck solenoid valve.	 Replace after disassembling. Replace after disassembling.
2	The output is low.	Oil pressure is low. 1) Deformed spring or piston malfunction of the inlet relief or regulator valve. 2) Stuck solenoid valve. 3) Inching valve operation.	 Check it after disassembling. Replace parts as necessary. Replace after disassembling. Adjust it.
3	Oil leaks.	Gasket joint surface. 1) Slacken bolt. 2) Broken gasket. 3) Flaw on the opposite surface.	 Retighten it. Replace after disassembling. Repair or replace it.
4	The electromagnetic valve does not function.	No voltage. 1) Failed forward/reverse travel lever switch. 2) Wrong connector contact. 3) Fused or disconnected fuse or wiring circuit. Voltage available. 1) Disconnected grounding circuit. 2) Wrong connector contact. 3) Wrong frame grounding wire contact. 4) Stuck solenoid valve. 5) Disconnected solenoid or wiring circuit.	 Repair or replace it after checking. Repair it after checking. Repair or replace it after checking. Repair it after checking. Repair it after checking. Repair it after checking. Repair or replace it after checking. Repair or replace it after checking.

DIFFERENTIAL

DISASSEMBLY AND ASSEMBLY



TESTING

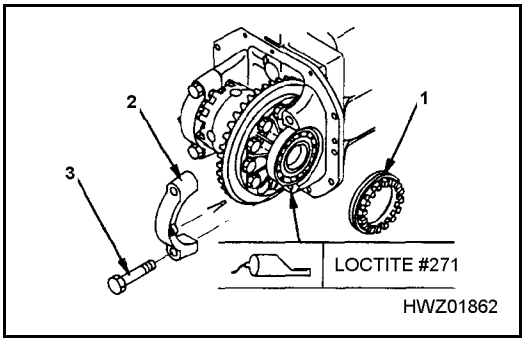

BACKLASH
H 0.15 - 0.23
APPLY LOCTITE #271 TO THE SCREW (HOLE SIDE)
TORQUE TO: 98 - 123 Nm (10 - 12.5 kgfm)
24 x 1.5
D
C
0.2 - 0
B
BACKLASH
0.20 - 0.28
A
G
F
E
J
I
K
HWZ01861

MAINTENANCE STANDARD

Symbol	Check item		Criteria		Remedy
			Standard size (mm)	Repair limit (mm)	
A	Differential pinion	Set starting torque	21.56 – 33.32 Nm {2.2 – 3.4 kgfm}		
		Backlash	0.20 – 0.28		
B	Outside diameter of spider and pin		27.959 – 27.980	27.75	
C	Inside diameter of pinion gear		28.0 – 28.052	28.152	
D	Pinion gear	Bushing thickness	1.52 – 1.68	1.3	
		Oil groove (W x D)	—	—	
E	Side gear	Bushing thickness	1.94 – 2.06	1.7	
		Oil groove (W x D)	—	—	
F	Differential case side gear boss	Inside diameter of mating hole	68 – 68.03	68.13	
		Oil groove (W x D)	4 x 1.5	4 x 1.4	
G	Outside diameter of differential case boss		90.013 – 90.035	—	
H	Bevel pinion gear backlash		0.15 – 0.23	—	
I	Runout on back of bevel gear		Max. 0.1	—	
J	Differential case tightening bolt		78.4 – 122.5 Nm {8 – 12.5 kgfm}	—	Apply Loctite to screw
K	Bevel gear mounting bolt		156.8 – 196 Nm {16 – 20kgfm}	—	Apply Loctite to screw
—	Differential carrier and support cap tightening bolt		490 – 608 Nm {50 – 62 kgfm}	—	Apply Loctite to screw
—	Differential gear tooth surface		—	Damage of tooth surface such as pitching and spalling	Replace
—	Gasket, O-ring and seals		—	—	Replace with new parts during disassembly and assembly

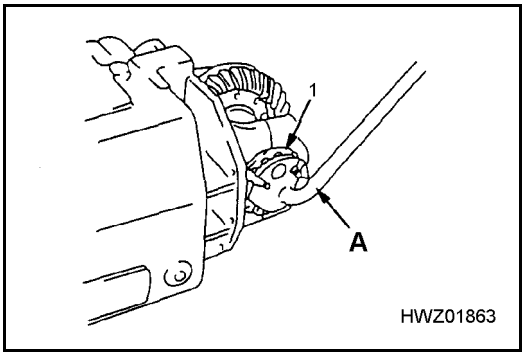
ADJUSTING DIFFERENTIAL

1) Assembly of differential assembly
   A) Assemble differential assembly. Then install adjustment screw (1)
   B) Coat hole of cap (2) with Loctite #271. Then tighten temporarily with bolts (3)

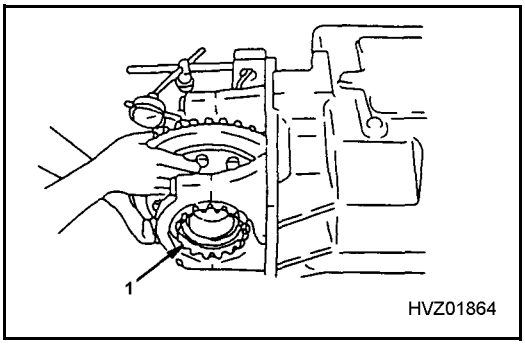


2) Adjusting backlash
   NOTE: When tightening adjustment screw (1), use special tool **# 34C-97-99150**
   A) When adjusting, turn either left or right adjustment screw (1) back one notch. Then tighten the other adjustment screw one notch and read dial gauge indicator.

Backlash between ring gear and pinion gear	0.15 - 0.23mm (0.006 - 0.009 in.)

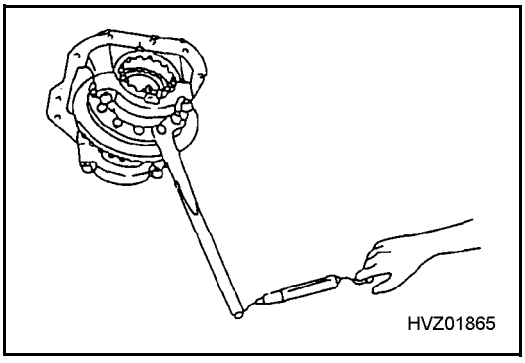


   B) Rotate bevel gear and carry out adjustment procedure in Step A) in four places.



3) Adjusting preload of side bearings
   A) Tighten left and right adjustment screws (1) uniformly to adjust preload.

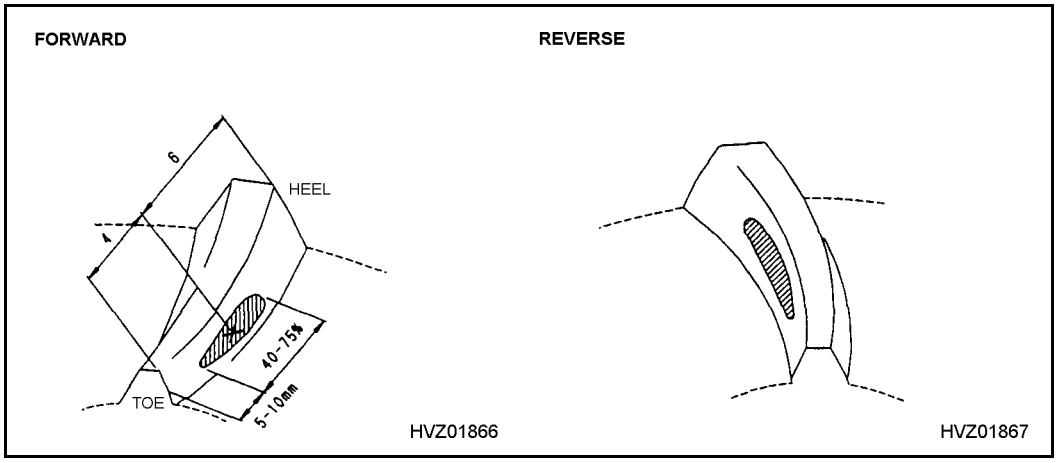
Preload	21.56 - 33.32 Nm (2.2 - 3.4 kgfm) (16 - 24.6 lbft)
Lubricant	Apply molybdenum grease



   B) Check again that backlash is within specified value.

4) Adjusting tooth contact
   A) Coat tooth surface of bevel gear thinly with red lead (minimum)
   B) Rotate bevel gear in forward and reverse directions several times
   C) Check tooth contact pattern left in red lead on tooth surface (see Figure below)

Correct tooth contact (no load)



NOTE: Pattern is in center of tooth surface and covers 40 - 75% of the overall length of the tooth. There should be weak contact at both ends of the pattern.

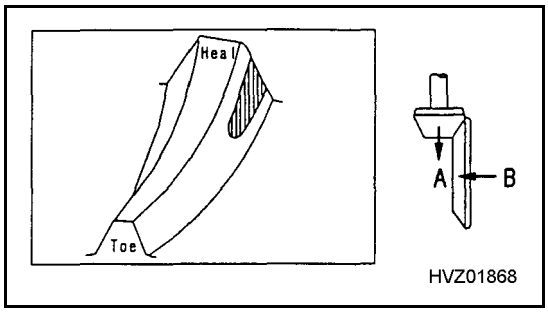
NOTE: Pattern is in center of tooth surface and covers 40 - 75% of the overall length of the tooth. There should be weak contact at both ends of the pattern.

D) If tooth contact is not correct, adjust as follows. (See next page for more detail.)
   1. Pinion shaft shim
   2. Backlash of bevel gear
   3. Preload of bevel gear side bearing

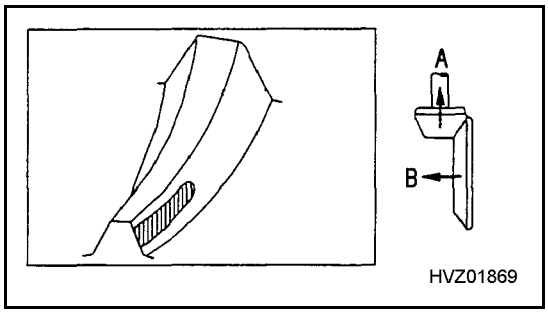
      NOTE: The tooth contact must be adjusted correctly for both forward and reverse directions, but if it is impossible to adjust completely in both directions, adjust the **forward** direction correctly.

Correcting tooth contact:

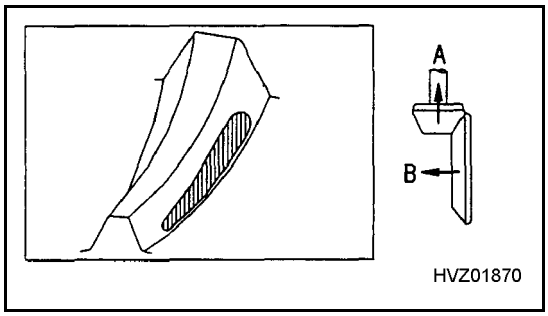
Increase the shims at the pinion shaft to increase the protrusion of the pinion. (Direction “A”)
Then, move the bevel gear away from the pinion (Direction “B”) and adjust the back lash.



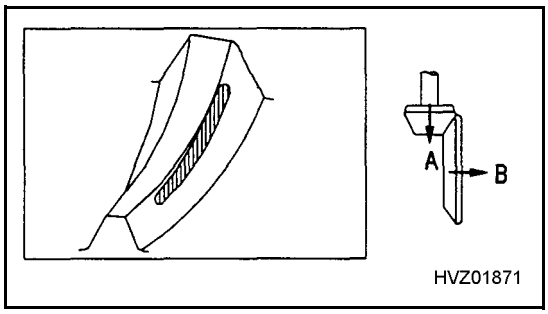
Decrease the shims at the pinion shaft to decrease the protrusion of the pinion. (Direction “A”)
Then, move the bevel gear closer to the pinion (Direction “B”) and adjust the backlash.



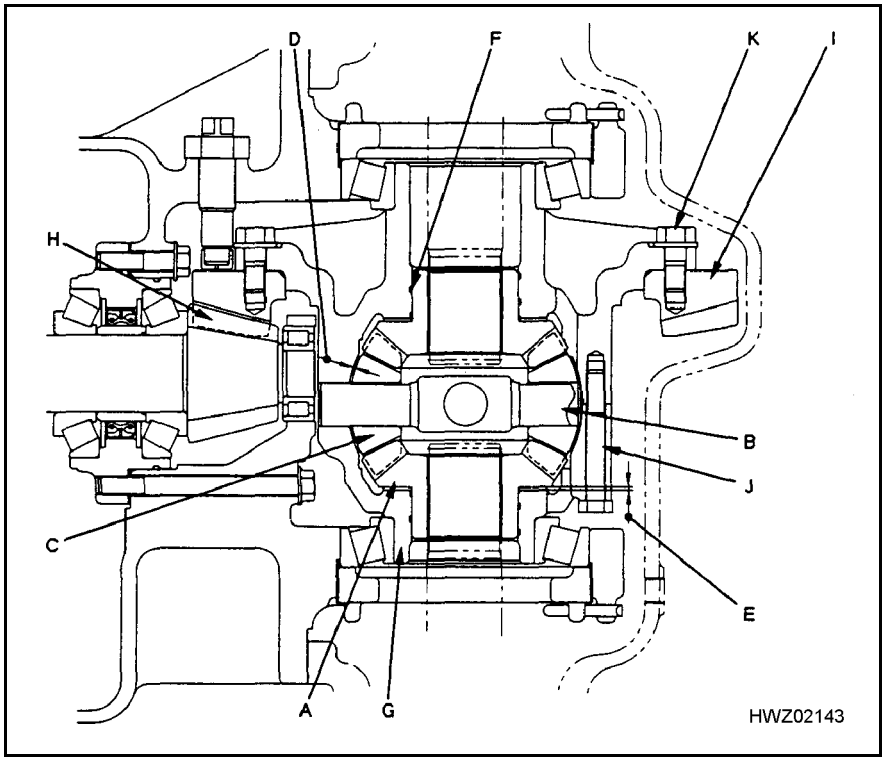
Decrease the shims at the pinion shaft to decrease the protrusion of the pinion. (Direction “A”)
Then, move the bevel gear closer to the pinion (Direction “B”) and adjust the backlash.

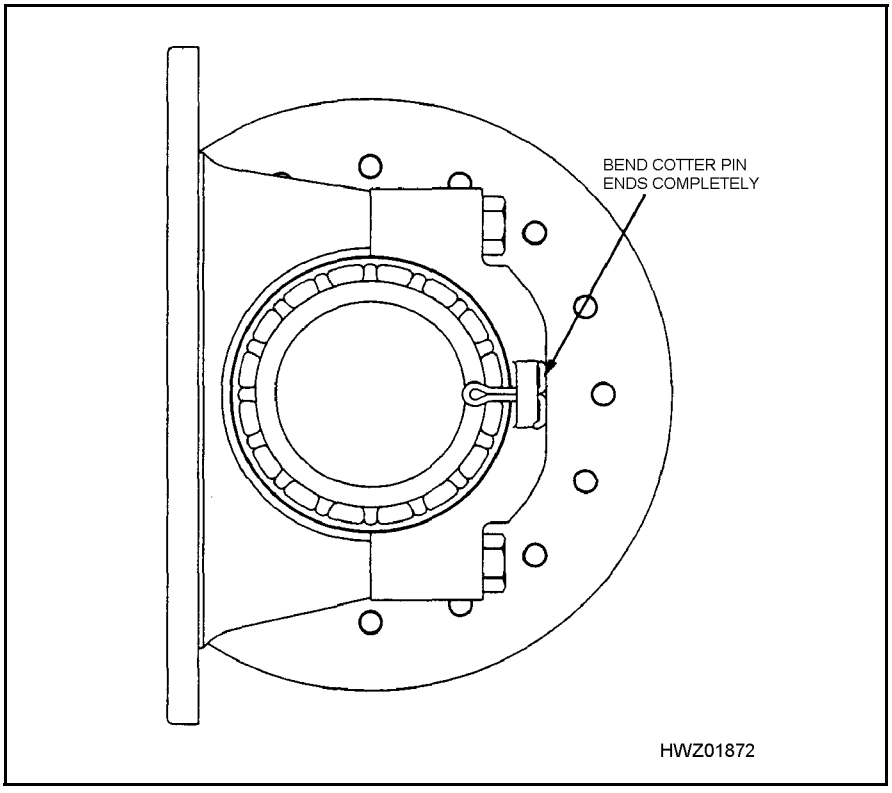


Decrease the shims at the pinion shaft to decrease the protrusion of the pinion. (Direction “A”)
Then, move the bevel gear away from the pinion (Direction “B”) and adjust the backlash.



DIFFERENTIAL ASSEMBLY DRAWING



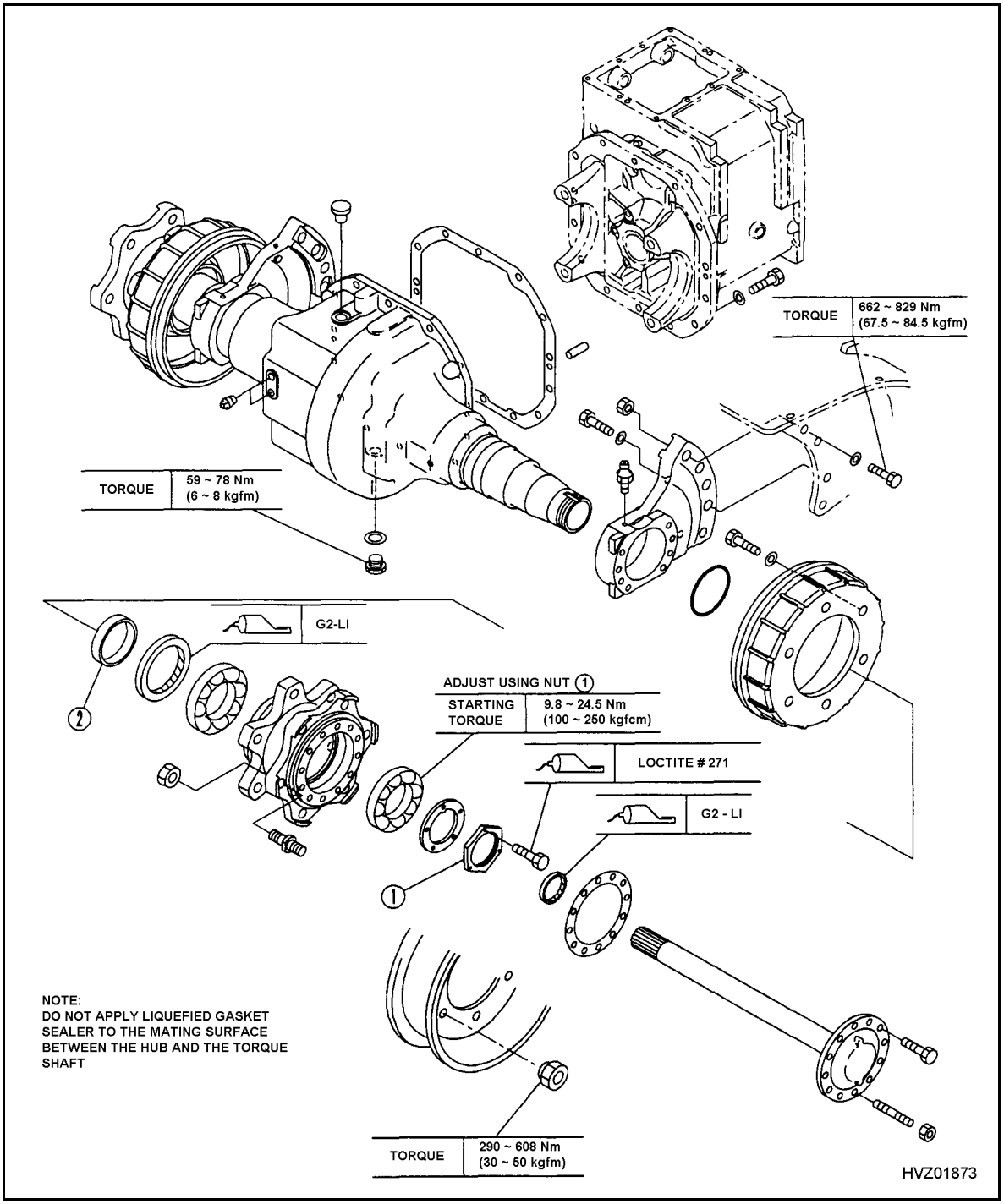


DRIVE AXLE (OUTDOOR LIFT TRUCK)

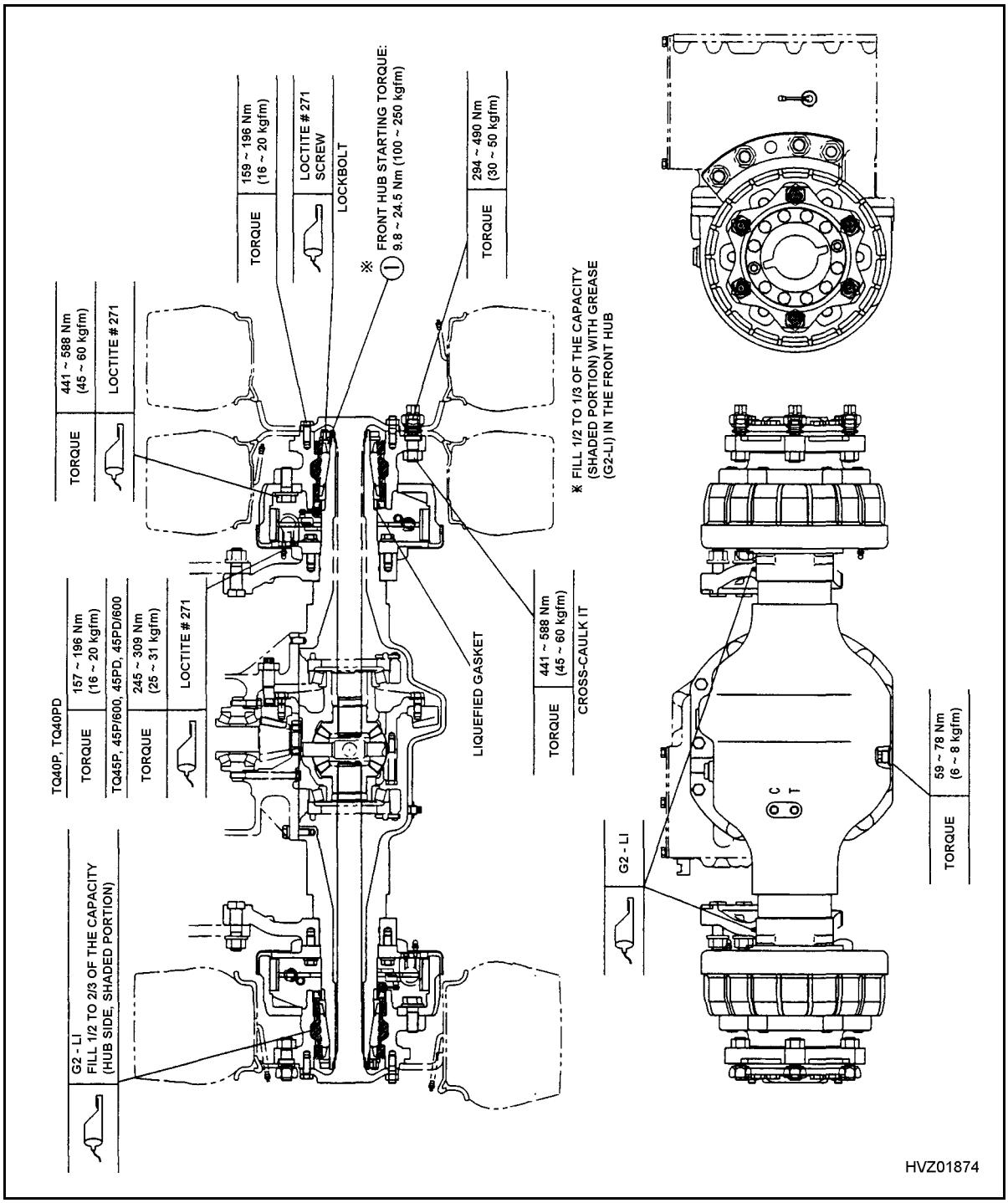
DISASSEMBLY AND ASSEMBLY

Precautions on installing the front axle on the frame

1) Degrease the mounting bolts, nuts and tapped holesbefore installation.
2) Tighten bolt and nuts by hand first (not an impact wrench), and then retighten using the wrench to check the tightening torque.



DRIVE AXLE ASSEMBLY DRAWING (OUTDOOR LIFT TRUCK)

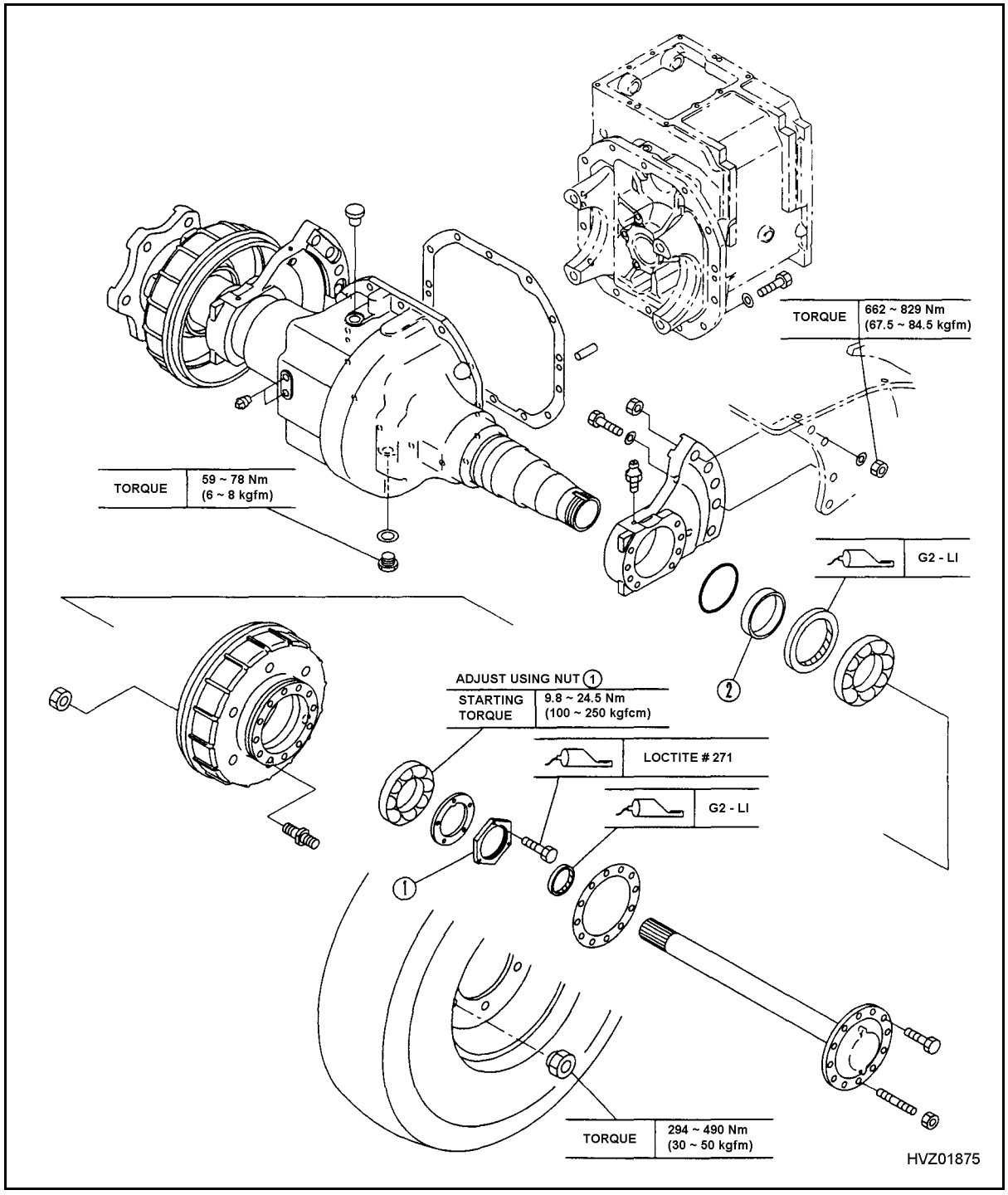


DRIVE AXLE (INDOOR LIFT TRUCK)

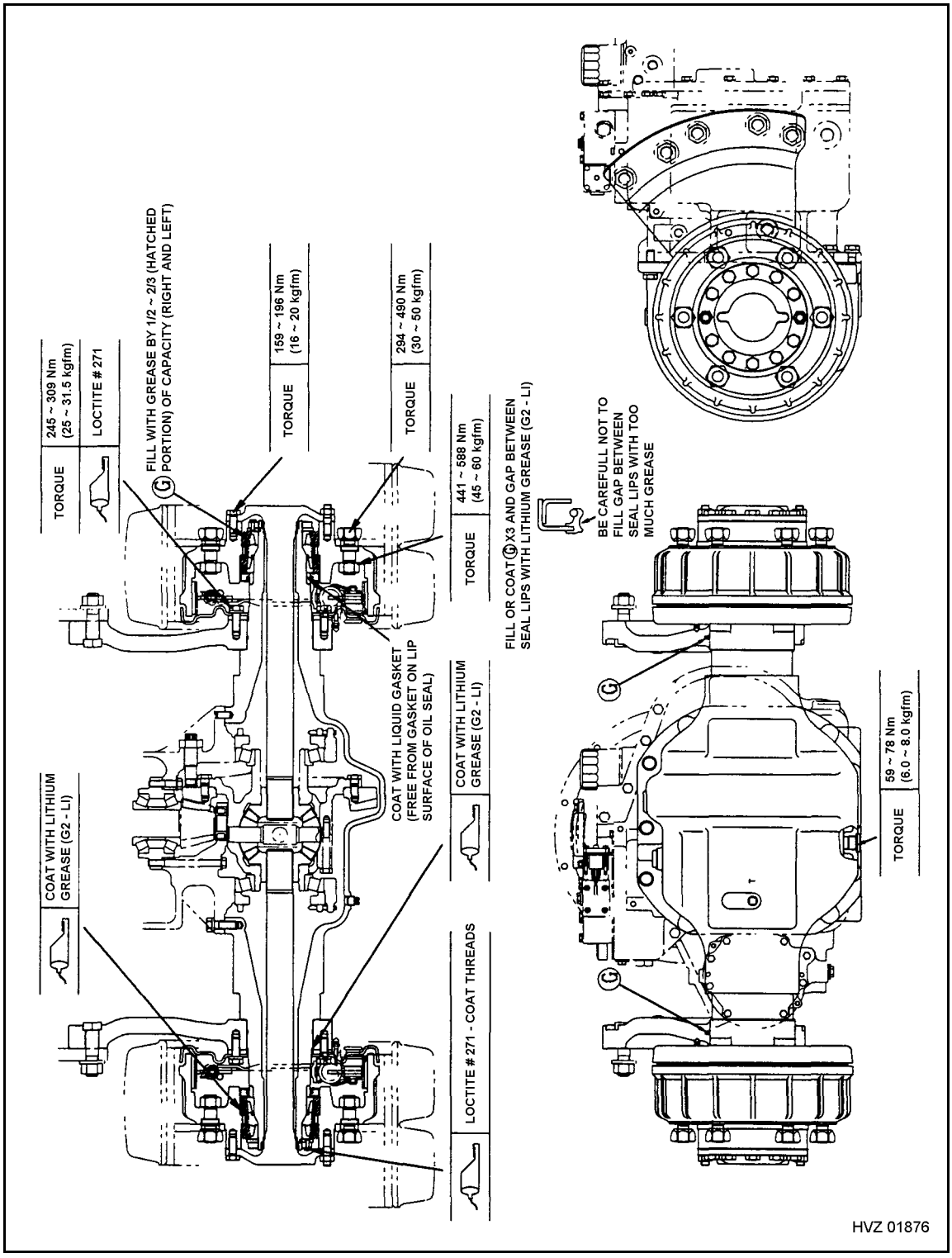
DISASSEMBLY AND ASSEMBLY

Precautions on installing the front axle in the frame

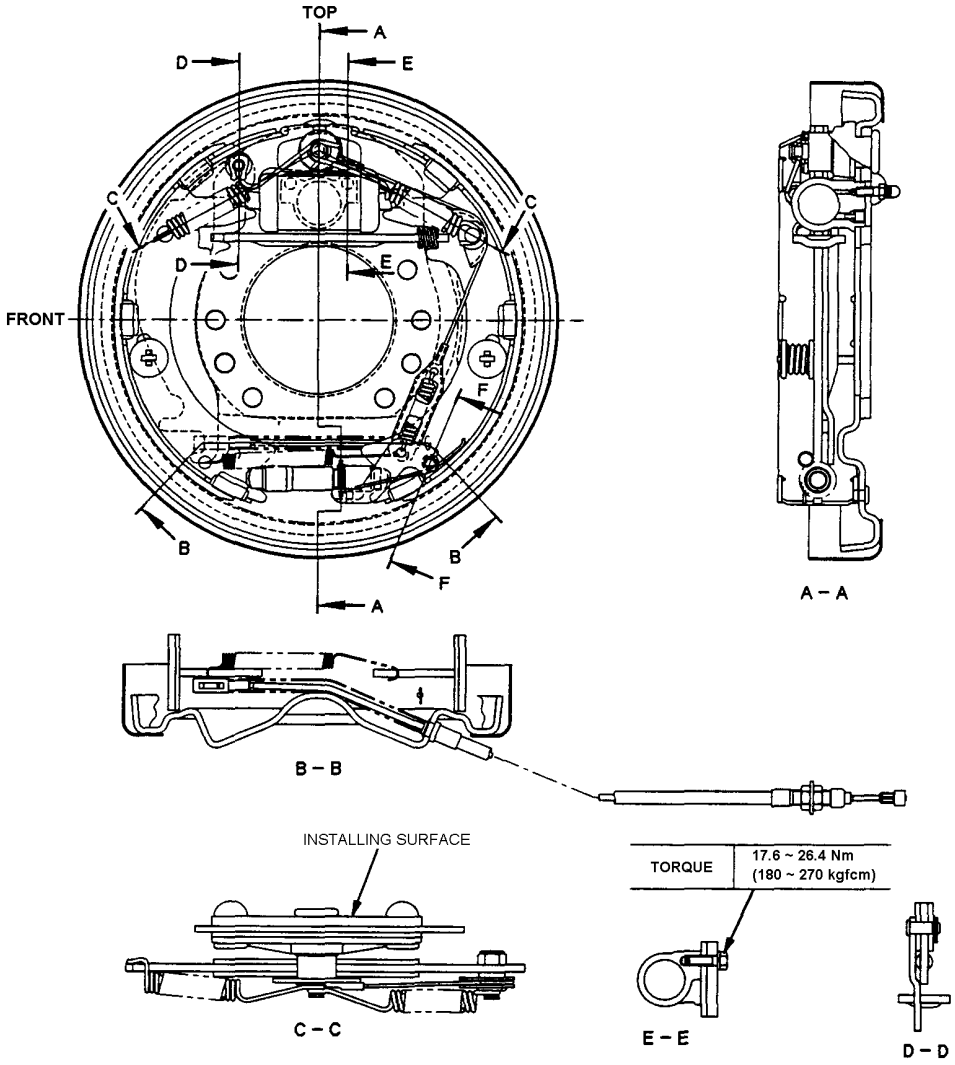
1) Degrease the mounting bolts, nuts and tapped holes before installation.
2) Tighten bolts and nuts by hand first (not an impact wrench), and then retighten using the wrench to check the tightening torque.



DRIVE AXLE ASSEMBLY DRAWING (INDOOR LIFT TRUCK)

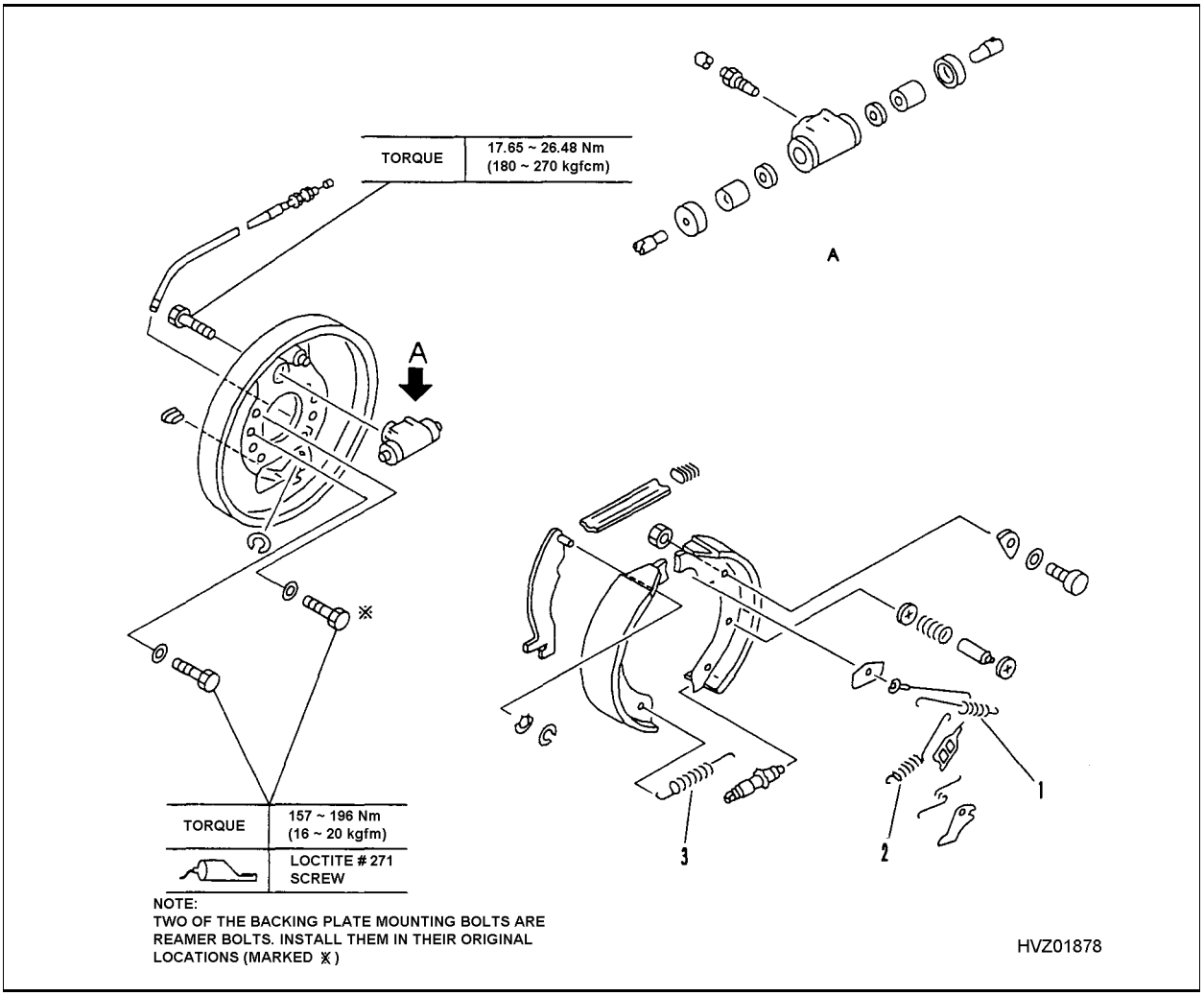


WHEEL BRAKE



Item	Unit	Wheel brake	
Type	–	Front wheel, internal expanding, hydraulic	
Structure	–	Duo servo	
Inner diameter of brake drum	mm	317.5 – 317.6	
Lining material	mm	Resin mold (Adhesive type)	
Width	mm	60.0 C80/100CX, P80CX G/D, C80CXC	63.0 (P80/100CX G/D)
Thickness	mm	5.62 C80/100CX, P80CX G/D, C80CXC	10.0 (P80/100CX G/D)
Inner diameter of wheel cylinder	mm	31.75	

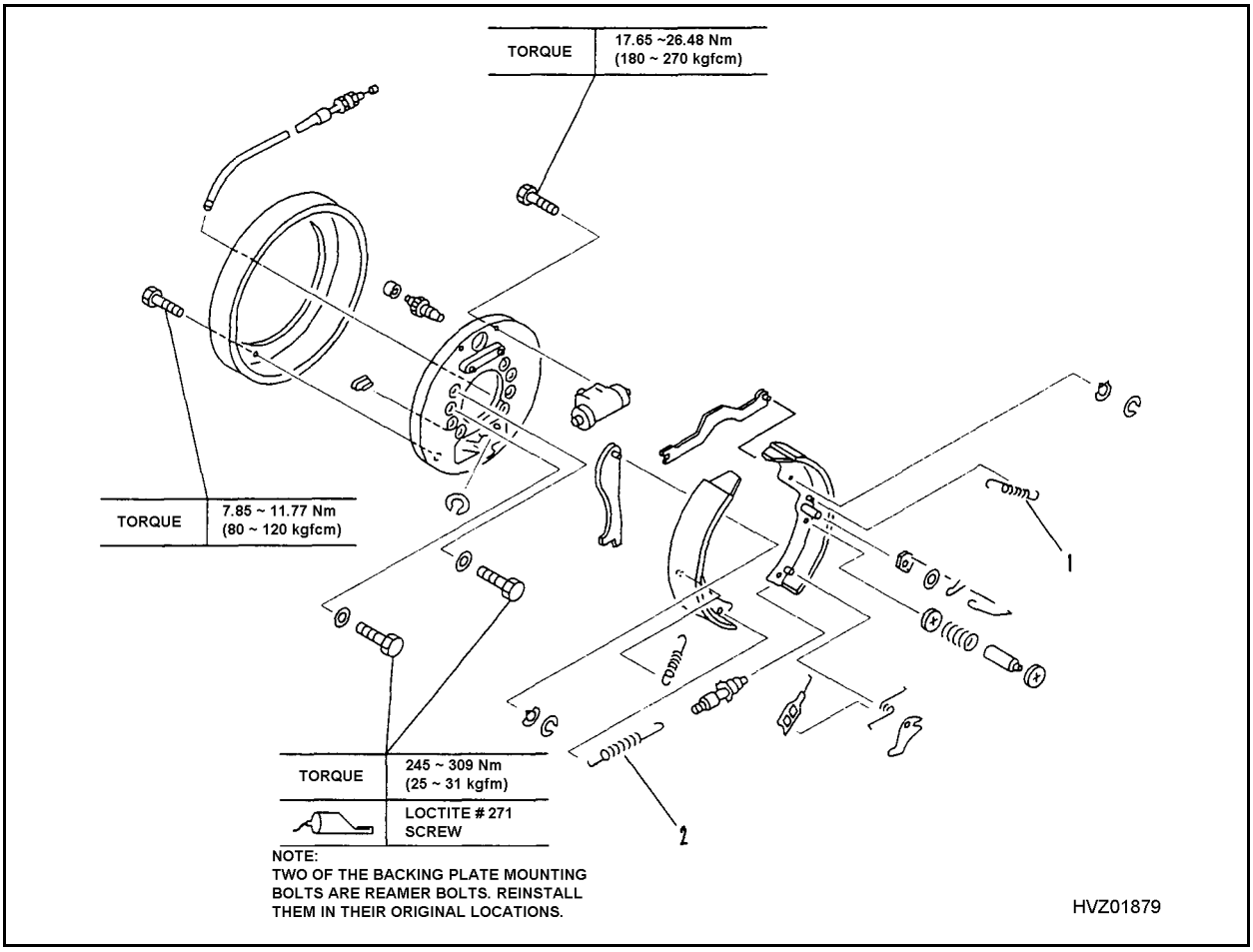
DISASSEMBLY AND ASSEMBLY (P80CX G/D, C80/100CX, C80CXC)



TESTING

Check item		Criteria		Remedy
		Standard size (mm)	Repair limit (mm)	
Inside diameter of drum		317.5 - 317.7	319.5	
Thickness of lining		5.62	2	
Deterioration of return spring	Springs 1 and 2	Free length: 120	Free length: 132	
	Spring 3	Free length: 139	Free length: 153	
Thickness of return spring hook portion		2.9	2.0	
Clearance between piston and cylinder		0 - 0.05	0.2	
Check for scratches on wheel cylinder sliding surface and for damage/deterioration of the cap.				

DISASSEMBLY AND ASSEMBLY (P90/100CX G/D)

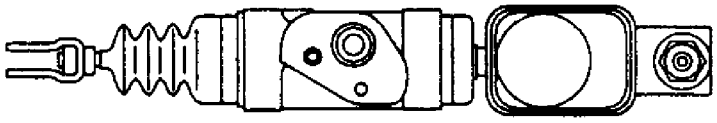


TESTING

Check item		Criteria		Remedy
		Standard size (mm)	Repair limit (mm)	
Inside diameter of drum		317.5 - 317.7	319.5	
Thickness of lining		10.0	2.0 (from the rivet head)	
Deterioration of return spring	Spring 1	Free length: 93	22.5 - 27.5 kgf (when length = 101.2mm)	
	Spring 2	Free length: 123.2	7.2 - 8.8 kgf (when length = 152mm)	
Thickness of return spring hook portion		2.9	2.0	
Clearance between piston and cylinder		0 - 0.05	0.2	
Check for scratches on wheel cylinder sliding surface and for damage/deterioration of the cap.				

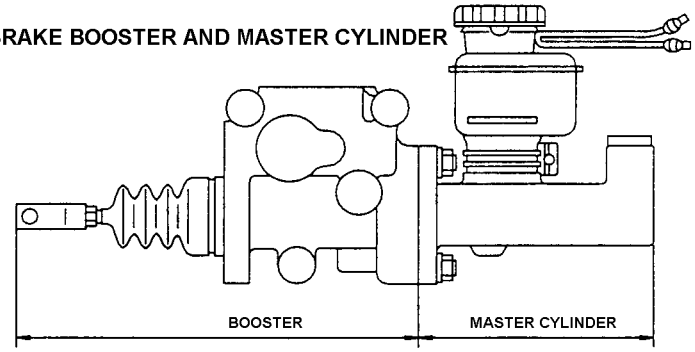
BRAKE BOOSTER AND MASTER CYLINDER (TORQFLOW LIFT TRUCK)

TOP VIEW OF BRAKE BOOSTER AND MASTER CYLINDER



HVZ01880

SIDE VIEW OF BRAKE BOOSTER AND MASTER CYLINDER

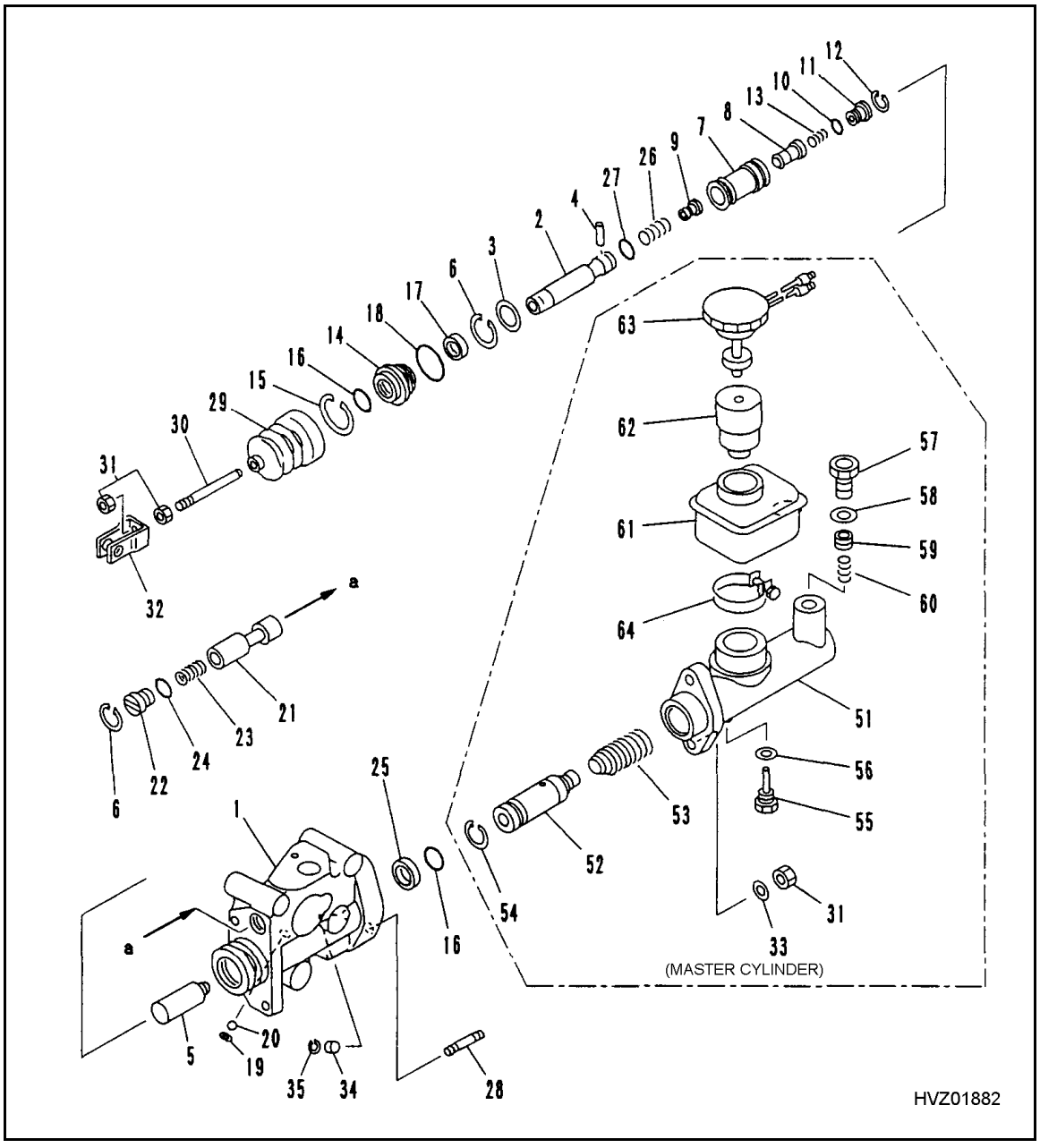


HVZ01881

SPECIFICATIONS

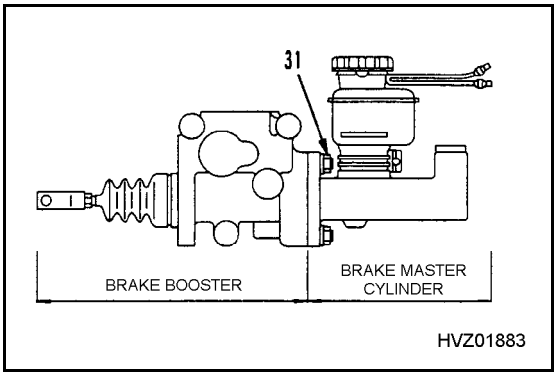
Item			Specifications (Values)	⚠ WARNING
Brake booster	Fluid used		Mineral hydraulic oil	**Never allow hydraulic oil and brake fluid to mix.**
	Cylinder diameter	mm (in.)	25.4 (1.0)	
	Maximum stroke	mm (in.)	28 (1.1)	
	Maximum operating pressure	MPa (psi)	14.7 (2,132)	**Never allow mineral oil (e.g. gas & petroleum) to touch or adhere to rubber parts. This will cause the parts to swell causing brake malfunction, failure and possibly an injury-causing accident.**
	Maximum flow		25L/min	
Brake master cylinder	Fluid used		Brake fluid	
	Cylinder diameter		25.4 (1.0)	
	Maximum stroke	mm (in.)	28 (1.1)	
	Maximum operating pressure	MPa (psi)	9.8 (1,421)	
	Residual pressure	MPa (psi)	Brake: 0.1 (14.5)	

BRAKE BOOSTER AND MASTER CYLINDER DISASSEMBLY DRAWING



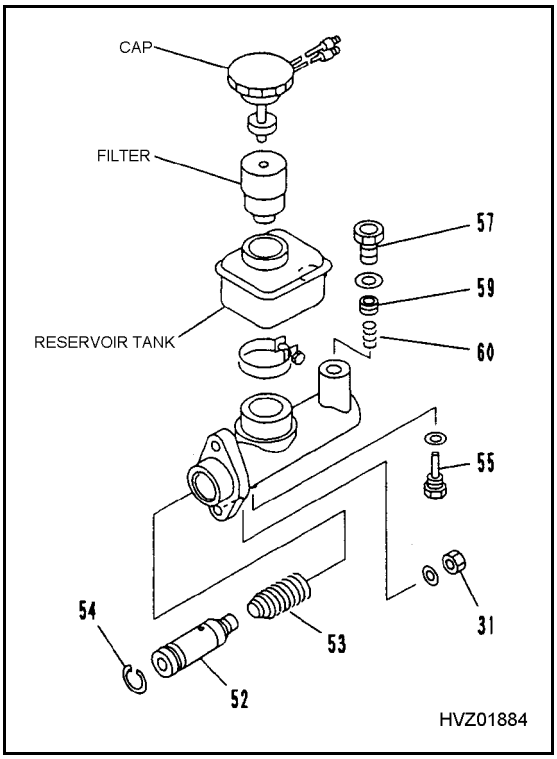
DISASSEMBLING AND ASSEMBLING BRAKE BOOSTER AND MASTER CYLINDER

- On clutch-equipped lift trucks, the brake and clutch boosters are assembled on each assembly. When disassembling them, be careful not to lose the O-ring on the mating face. It cannot be purchased separately.
- The Torqflow equipped lift trucks use a single unit consisting of the brake booster and master cylinder assemblies.



1) Separating the booster and master cylinder
   Remove nut (31) to separate the booster from the master cylinder.

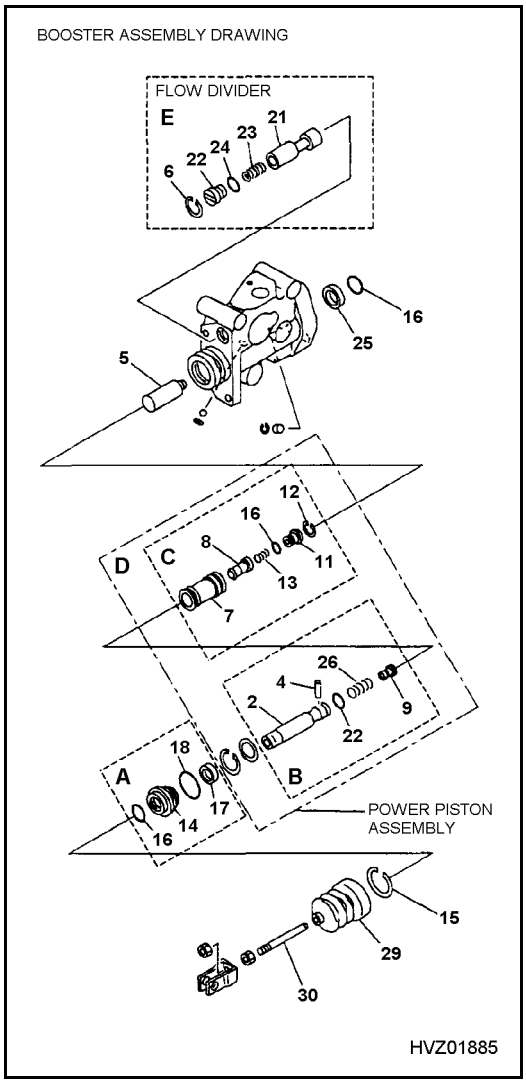
2) Disassembling the master cylinder
   A) Remove snap ring (54)
   B) Remove stop pin (55)
      Remove the stop pin by pressing the piston assembly after loosening the stop pin.
   C) Remove piston assembly (52) and spring (53)
      If they cannot be removed easily, slightly press the piston assembly so that it comes out under the spring pressure.
   D) Remove bolt (57) to pull out check valve (59) and spring (60) from the cylinder.



3) Disassembling the booster
   A) Remove push rod (30) and boot (29)
   B) Remove snap ring (15)
   C) Press rod (5) from the master cylinder side to remove piston guide (A), power piston assembly (D) and the rod

   See Figure at right:
   A: PISTON GUIDE SUB-ASSEMBLY
   B: REACTION PISTON SUB-ASSEMBLY
   C: CONTROL VALVE SUB-ASSEMBLY
   D: POWER PISTON ASSEMBLY
   E: FLOW DIVIDER

   Disassembling the sub-assembly
   A) Reaction piston sub-assembly
      Disassemble by pressing valve (9) and pulling pin (4)
   B) Control valve sub-assembly
      Remove snap ring (12) to pull out cap (11), spring (13) and valve (8)
   C) Flow divider
      Remove snap ring (6), cap (22), spring (23) and valve (21)



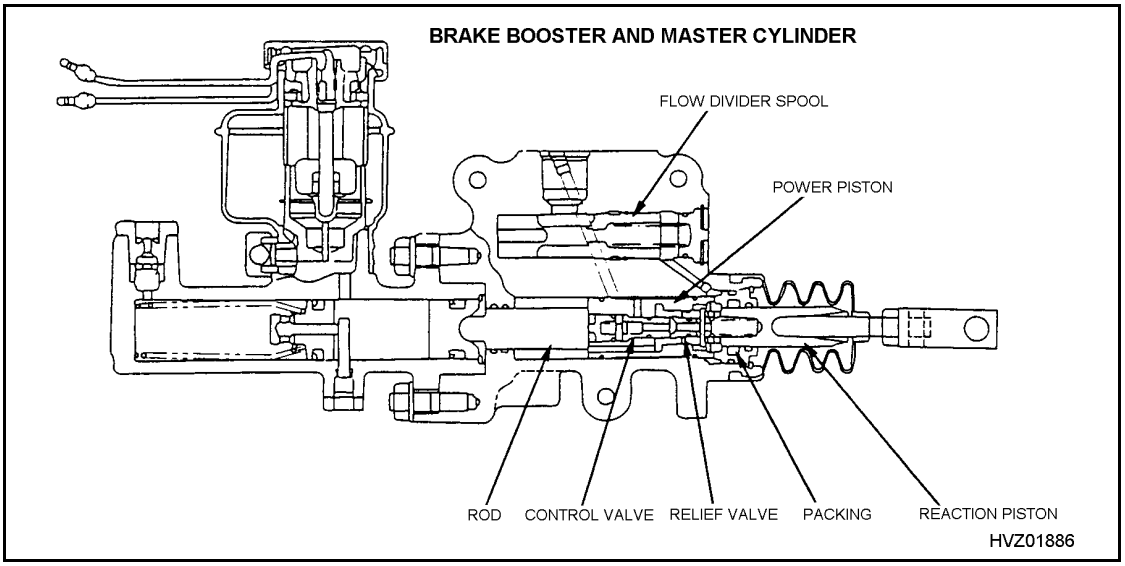
WARNING

- **Do not damage the cylinder, piston, cups, etc.**
- **During disassembling, pay close attention to the location of each part and how each part comes out of the assembly. Place these parts in order to ensure they can be reassembled in the correct sequence.**
- **When using a vice to hold a part, clamp to the mounting flange and do not apply excessive force.**
- **Do not remove the piston and valve set seals (replace as an assembly).**

INSPECTION AND TESTING

NOTE: Follow the precautions below when cleaning parts before inspection:

- Use ONLY alcohol or brake fluid for cleaning parts. NEVER use mineral oil based liquids such as petroleum, gasoline, etc.
  Mineral oil based liquids will cause the rubber parts to swell and become unusable.
- When cleaning rubber parts, such as cups, with alcohol, do not dip them in alcohol for more than 30 seconds.
- After cleaning parts, keep them in a clean place to prevent dirt from contaminating parts.
- Do not allow foreign matter (dust, dirt, grease, etc.) to enter or damage the cylinder, piston, cups, or other parts. All brake parts must be kept clean to avoid malfunction and possible failure.

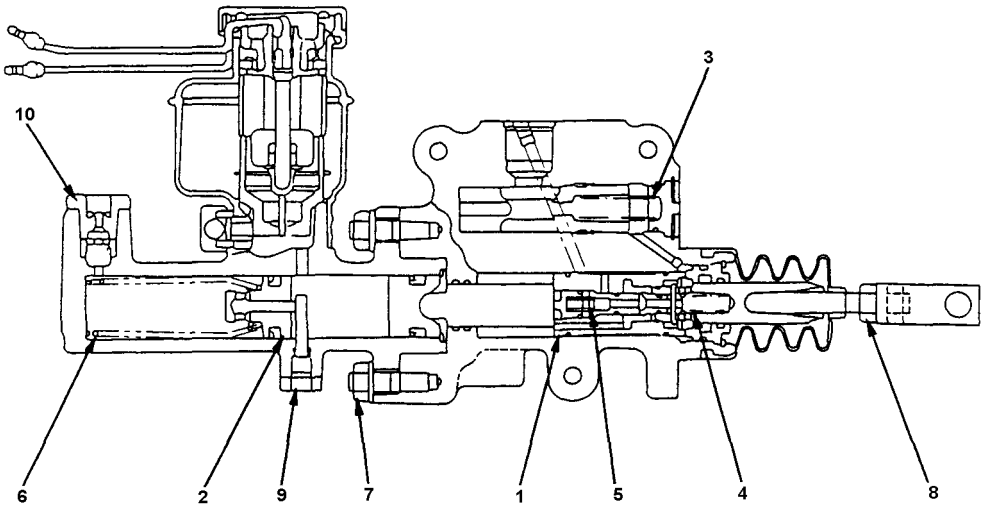


Booster side

No.	Parts	Check item	Check procedure	Remedy
1	Cylinder	Flaw or wear on sliding surface	Remove small flaws with fine emery cloth. Replace assembly if flaw will affect or prevent sealing of parts.	Replace the booster assembly
		Clearance between cylinder and piston	Replace if clearance is less than the limit	
2	Power piston assembly	Flaw or wear on sliding surface	Remove small flaws using fine emery cloth	Replace the piston assembly
		Damaged seal	Replace if damage or wear shows on seal	
3	Control and relief valve assemblies	Flaw or wear on sliding surface	Remove small flaws using fine emery cloth	Replace the valve assembly
		Damaged seal	Replace if damage or wear shows on seal	
4	Reaction piston assembly	Flaw or wear on sliding surface	Remove small flaws using fine emery cloth	Replace
		Damaged seal	Replace if damage or wear shows on seal	
5	Spring	Flaw, wear or fall (weakness)	Replace if flaw or major wear is detected	Replace
		Free length	Replace if length is below the limit	
6	Rod	Flaw or wear on sliding surface	Remove small flaws with fine emery cloth	Replace
7	Flow divider spool	Flaw or wear on sliding surface	Remove small flaws with fine emery cloth. Replace if flaw will affect or prevent sealing of parts.	Replace
8	Packing, O-ring and penta seal	Flaw or wear on seal surface	Replace if flaw or major wear is detected	Replace

MAINTENANCE STANDARD

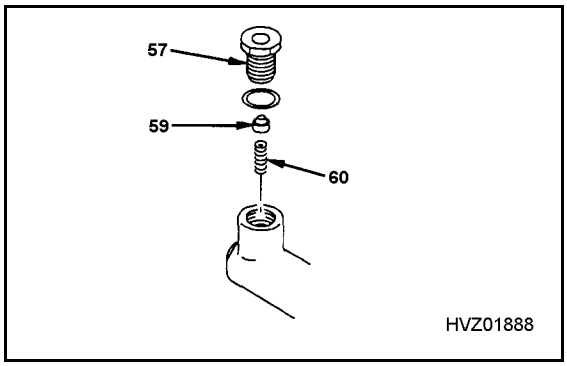
BRAKE BOOSTER AND MASTER CYLINDER



No.	Check item	Standard value				Allowable limit	Remedy
1	Clearance between cylinder and piston	**Basic dimensions**	**Shaft**	**Hole**	**Standard clearance**	**Limit clearance**	Replace
		25.4	- 0.020 - 0.053	+ 0.052 0	0.020 ~ 0.105	0.150	
2	Clearance between cylinder and piston	25.4	- 0.020 - 0.053	+ 0.052 0	0.020 ~ 0.105	0.150	
3	Deterioration of spring	**Free length**	**Installed length**	**Installed load (kgf)**	**Free length**		
		37.5	33.5	7.1	36.0		
4	Deterioration of spring	22.9	19.5	6.1	22.0		
5	Deterioration of spring	12.2	10.5	3.1	11.5		
6	Deterioration of spring	106	68.5	10.3	96		
7	Tightening torque	21 - 30 Nm (2.1 - 3.1 kgfm)			--		Retighten
8	Tightening torque	7.8 - 11.7 Nm (0.8 - 1.2 kgfm)			--		
9	Tightening torque	17.6 - 21.6 Nm (1.8 - 2.2 kgfm)			--		
10	Tightening torque	39.2 - 44.1 Nm (4.0 - 4.5 kgfm)			--		

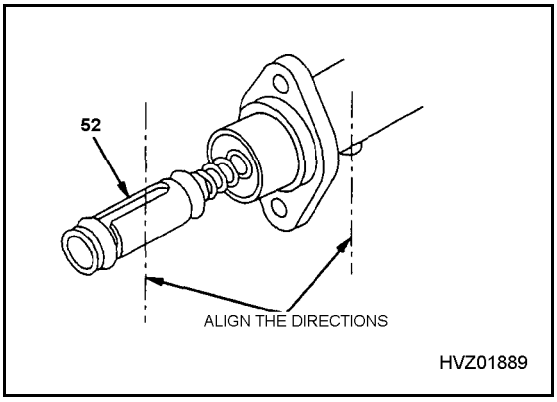
ASSEMBLY

1) Assembling the brake master cylinder
   A) Clean parts to be reused with alcohol or brake fluid.
      When cleaning rubber parts, such as cups, with alcohol, do not dip them in alcohol for more than 30 seconds.
   B) Completely apply rubber grease or brake fluid to the inside of the cylinder and the outer piston circumference.
   C) Assemble valve spring (60) and check valve (59) with the cylinder and tighten bolt (57) and gasket to the cylinder.



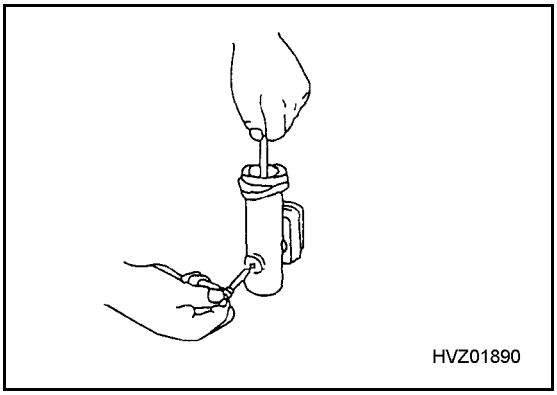
Torque	39.2 - 44.1 Nm (4 - 4.5 kgfm) (28.9 - 32.5 lbft)

   D) Assemble piston assembly (52) and, with the spring, insert them into the cylinder. At this time, align the directions of the piston groove and the stop pin hole.
   E) Assemble the gasket with the stop pin and insert them, with the piston inserted, into the cylinder.



Torque	17.6 - 21.6 Nm (1.8 - 2.2 kgfm) (13.0 - 16.0 lbft)

   F) Slightly press the piston and hold in place using the snap ring.

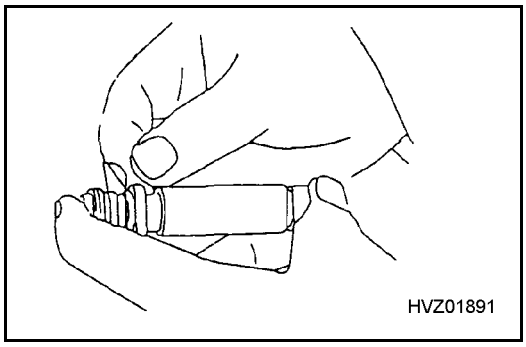


NOTES:

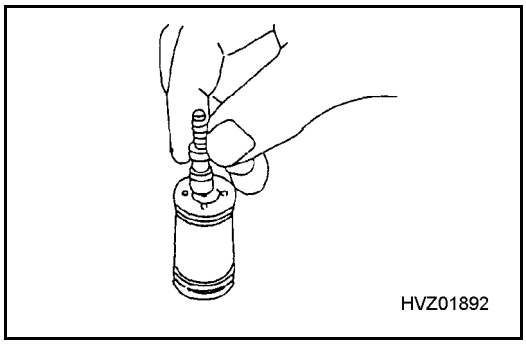
- **Be sure to use alcohol or brake fluid to clean parts.**
  Never use mineral oil (e.g. petroleum or gasoline). If mineral oil adheres to rubber parts, they will swell and become unusable.
- **Keep parts in a clean location, away from dirt or contamination, after cleaning.**
- **Do not allow dirt, dust or foreign matter to enter the cylinder, piston, cups, etc., and do not damage the parts.**

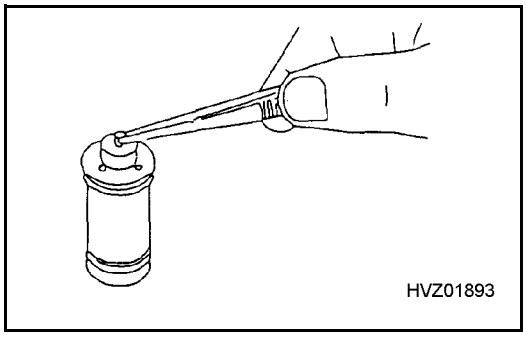
2) Assembling the booster (refer to the disassembly drawing)
   - Clean parts to be reused with detergent or mineral hydraulic oil.
   - Use mineral hydraulic oil to clean rubber parts. Do not clean them with detergent oil, petroleum or gasoline.

A) Assembling the reaction piston sub-assembly
   - Assemble the O-ring with the reaction piston.
   - Insert spring in the hole of the reaction piston.
   - Insert the relief valve by matching the relief valve and reaction piston holes. Insert the pin after making sure that the holes have overlapped.

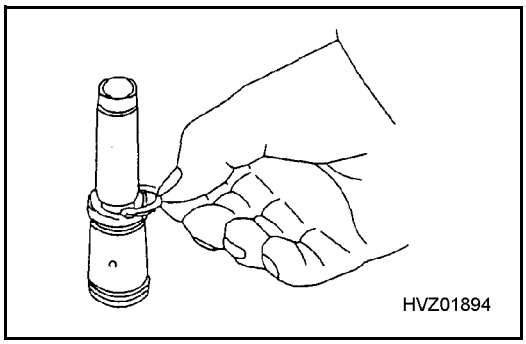

HVZ01891

B) Assembling the control valve
   - Apply hydraulic oil to the control valve and insert it, together with the spring, to the power piston.
   - Assemble the O-ring with the cap, insert them to the power piston and assemble them using a snap ring.

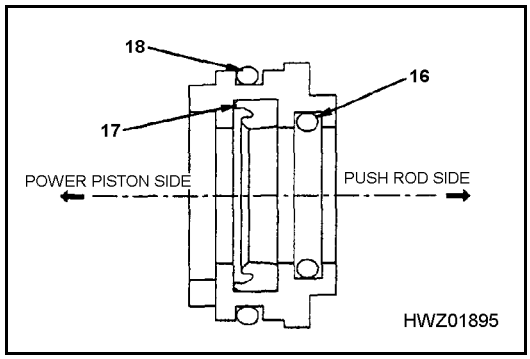

HVZ01892


HVZ01893

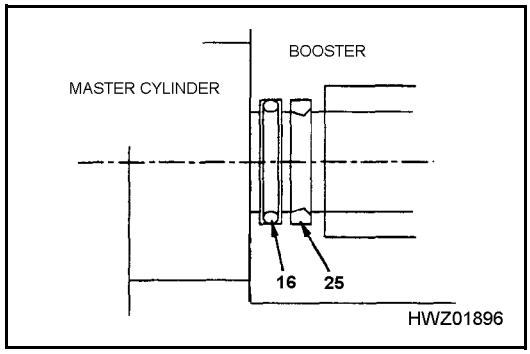
C) Assembling the power piston sub-assembly
   - Apply hydraulic oil to the reaction piston and insert it to the power piston.
   - Insert the ring from the side and assemble them using a snap ring.


HVZ01894

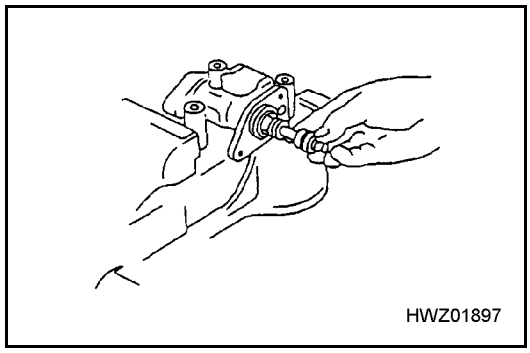
D) Assembling the piston guide
- Apply grease to cup (17) and O-rings (16) and (18), and assemble them with the piston guide in the proper direction.



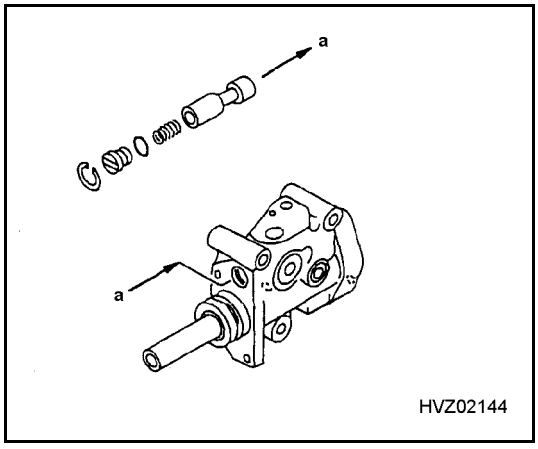
E) Assembling the seal with the body
- Apply grease to seal (25) and O-ring (16) and assemble them with the body in the proper direction.



F) Assembling the power piston assembly
- Apply grease to the rod and assemble with the body
- Apply hydraulic oil to the inside of the cylinder and the outer circumference of the power piston and insert the power piston assembly into the cylinder.
- Assemble the piston guide with the reaction piston, completely pressing them, and assemble them using a snap ring.



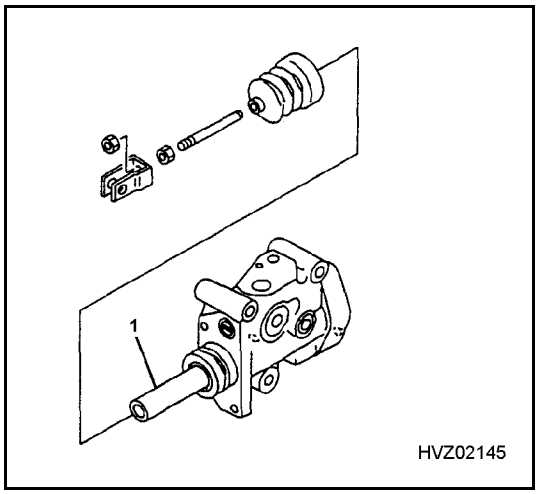
G) Assembling the flow divider
- Apply hydraulic oil to the spool and insert it into the body in the proper direction.
- After checking that the spool operates smoothly, insert the spring.
- Assemble the O-ring with the cap, apply grease and assemble the spring by compressing it and secure using a snap ring.



H) Assembling the boot
Assemble the boot after pressing reaction piston (2) by hand to ensure that it operates smoothly.

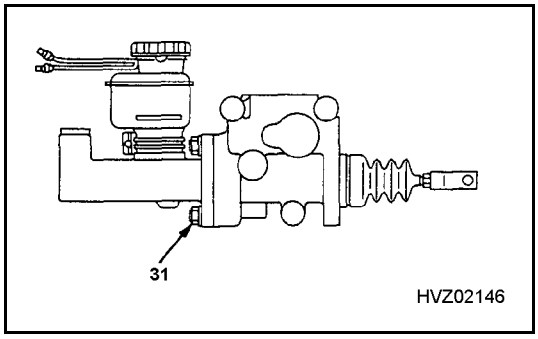
I) Assembling the push rod and yoke
- Assemble the lock nut with the push rod and connect them to the yoke with the nut inserted.
- Pass the push rod through the boot and assemble them to the hole of the reaction piston (2).

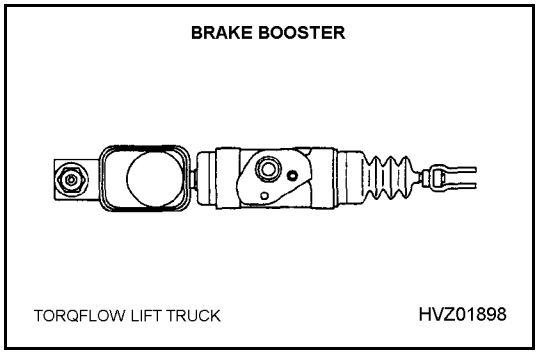
Lock nut Torque	7.8 - 11.7 Nm (80 - 120 kgfm) (5.75 - 8.6 lbft)



J) Joining the clutch booster and the master cylinder
Assemble the booster and clutch master cylinder assemblies and tighten them using nut (31).

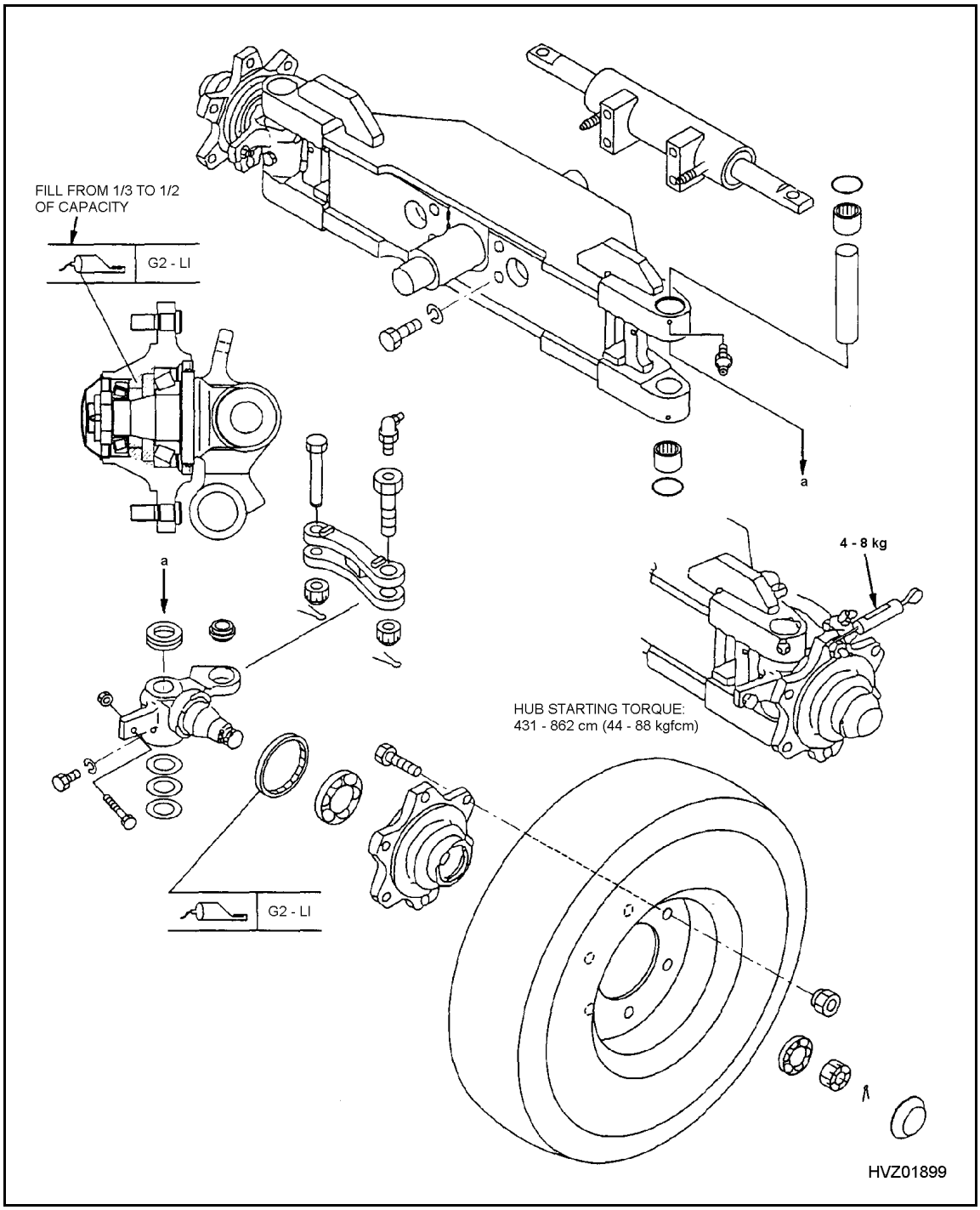
Torque	20.6 - 30.3 Nm (2.1 - 3.1 kgfm) (15.2 - 22.3 lbft)

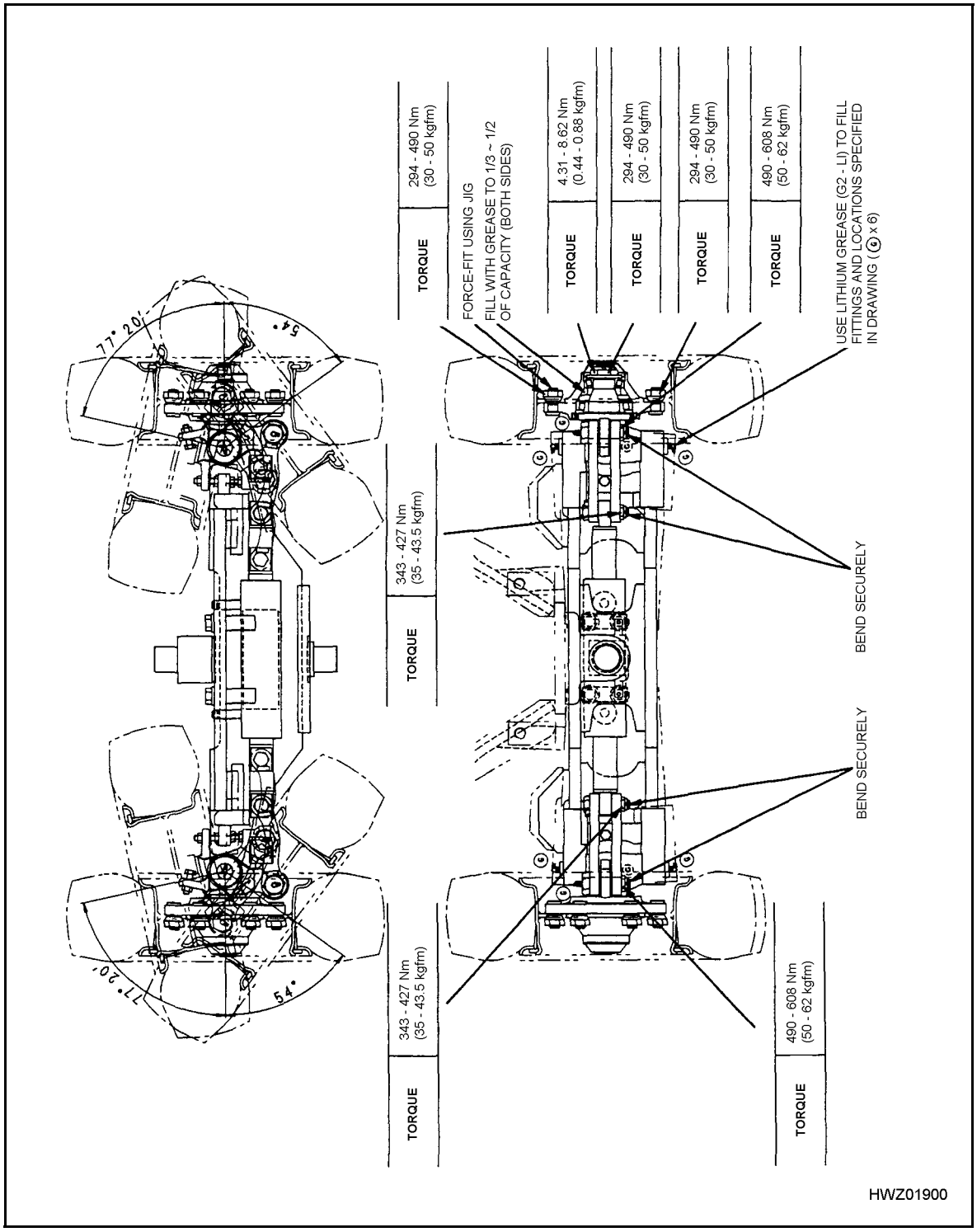




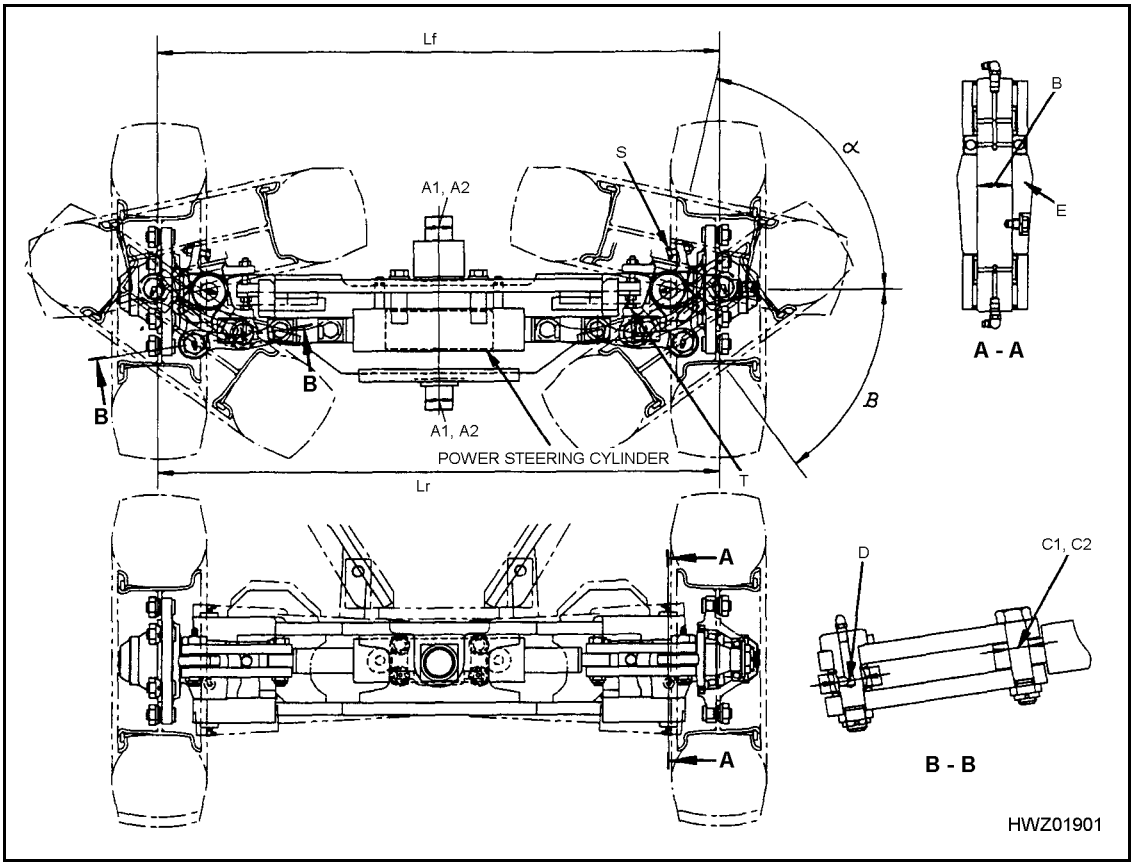
REAR AXLE

STRUCTURE




77° 20'
54°
77° 20'
54°
TORQUE
343 - 427 Nm
(35 - 43.5 kgfm)
TORQUE
343 - 427 Nm
(35 - 43.5 kgfm)
TORQUE
294 - 490 Nm
(30 - 50 kgfm)
FORCE-FIT USING JIG
FILL WITH GREASE TO 1/3 ~ 1/2
OF CAPACITY (BOTH SIDES)
TORQUE
4.31 - 8.62 Nm
(0.44 - 0.88 kgfm)
TORQUE
294 - 490 Nm
(30 - 50 kgfm)
TORQUE
294 - 490 Nm
(30 - 50 kgfm)
TORQUE
490 - 608 Nm
(50 - 62 kgfm)
TORQUE
490 - 608 Nm
(50 - 62 kgfm)
USE LITHIUM GREASE (G2 - LI) TO FILL
FITTINGS AND LOCATIONS SPECIFIED
IN DRAWING (ⓔ x 6)
BEND SECURELY
BEND SECURELY
HWZ01900

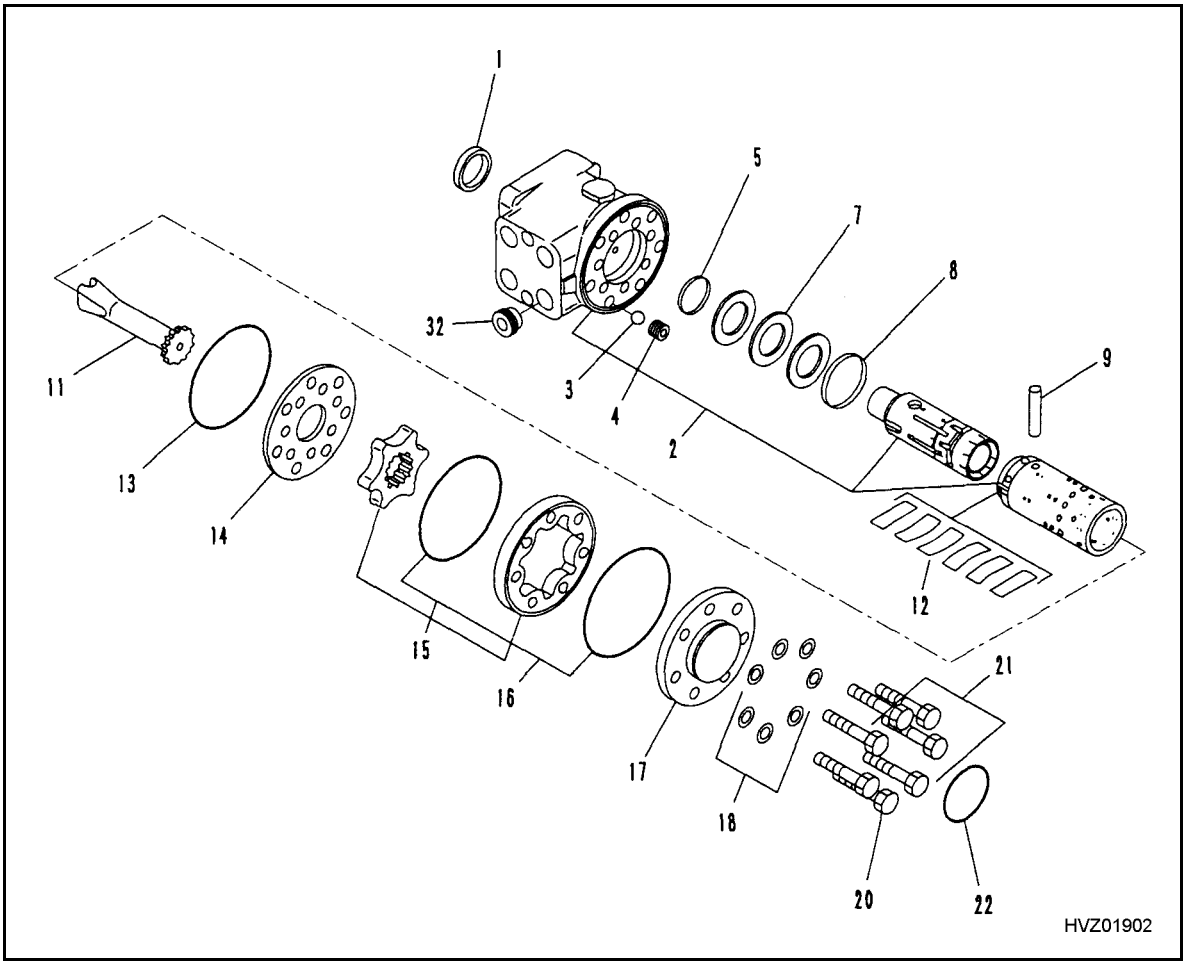
MAINTENANCE STANDARD



Mark	Item	Standard size	Repair limit	Remedy
A1	O. D. of center pin	55 mm	54.5 mm	Replace
A2	I. D. of center pin bushing	55 mm	55.5 mm	
B	O. D. of king pin	35 mm	34.8 mm	
C1	O. D. of power steering pin	20 mm	19.9 mm	
C2	I. D. of power steering pin bushing	20 mm	20.5 mm	
D	Backlash of knuckle pin bushing	--	No backlash	
E	Clearance of knuckle	--	0.2 mm	Adjust shims
α / B	Turning radius (degree) Pneumatic tire lift truck	76°45' (77°20') 54 (54)	--	Adjust

PS VALVE

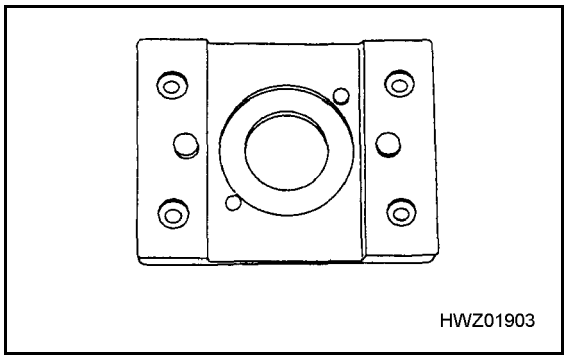
COMPONENT PARTS



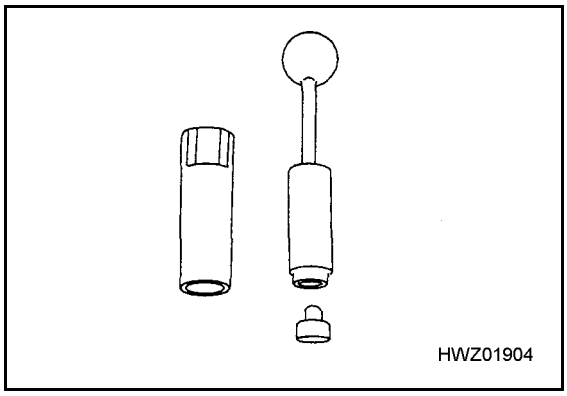
Item	Parts name	Item	Parts name
1	Dust seal ring	13	O-ring
2	Housing and spool	14	Distributor plate
3	Ball	15	Gear wheel set
4	Thread bushing	16	O-ring
5	O-ring	17	End cover
7	Bearing assembly	18	Washer
8	Ring	20	Screw with pin
9	Cross pin	22	Name plate
11	Control shaft	32	Check valve
12	Spring/Spacer set		

TOOLS

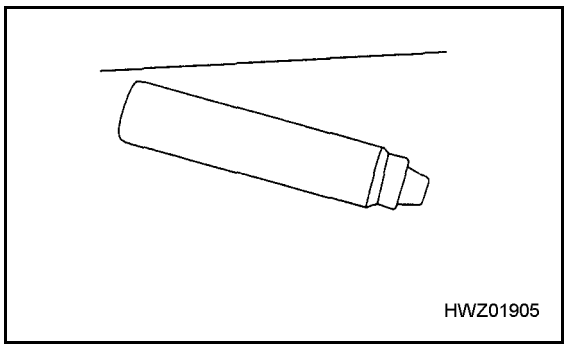
A) Holding tool
Code No.: SJ 150-9000-2



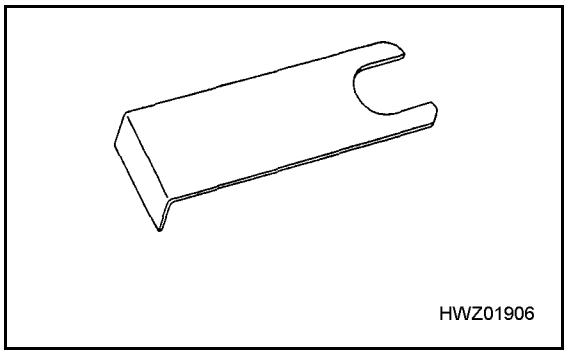
B) Assembly tool for O-ring and seal ring
Code No.: SJ 150-9000-11



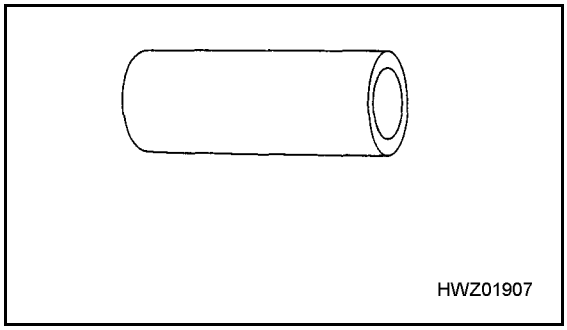
C) Assembly tool for lip seal
Code No.: SJ 150-9000-17



D) Assembly tool for control shaft
Code No.: SJ 150-9000-3

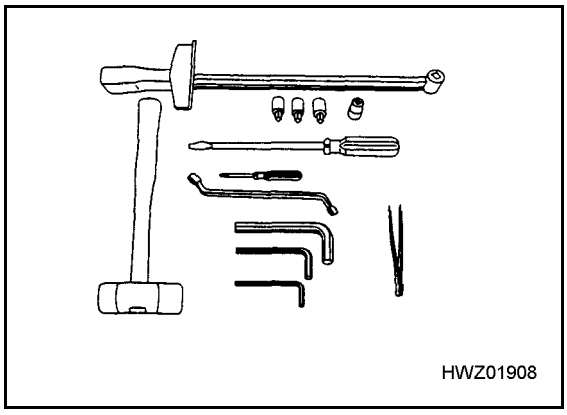


E) Assembly tool for dust seal
Code No.: SJ 150-9000-22



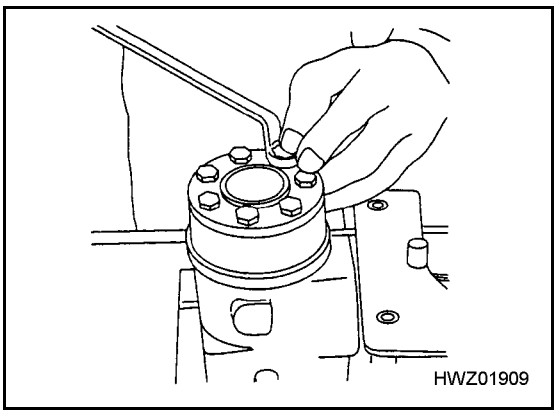
F) Torque wrench 0 - 7 daNm
13mm socket spanner
6, 8 and 12mm hexagonal sockets
12mm screwdriver
02mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagonal spanners
Plastic hammer
Tweezers

The tools itemized in item F) are available locally and not sold through the manufacturer.

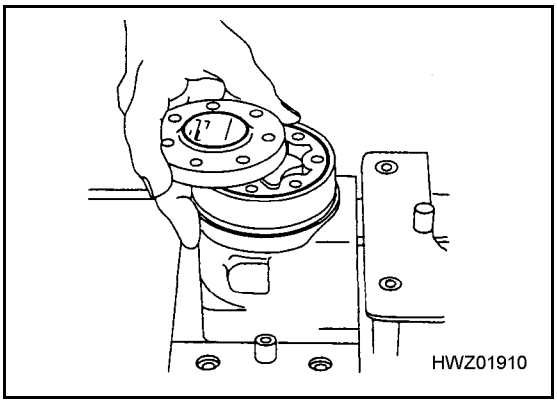


DISASSEMBLY

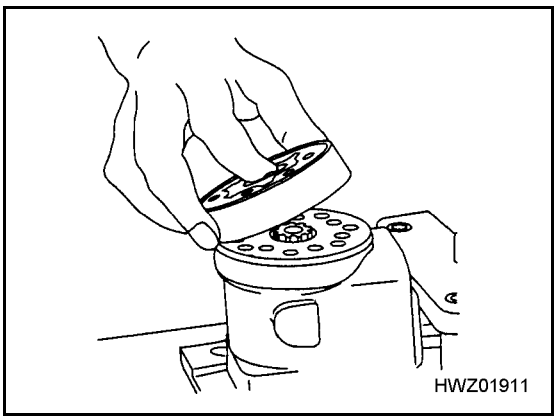
1) Dismantle steering column from steering unit and place the steering unit in the holding tool. Remove the screws in the end cover (6 each plus one special screw)



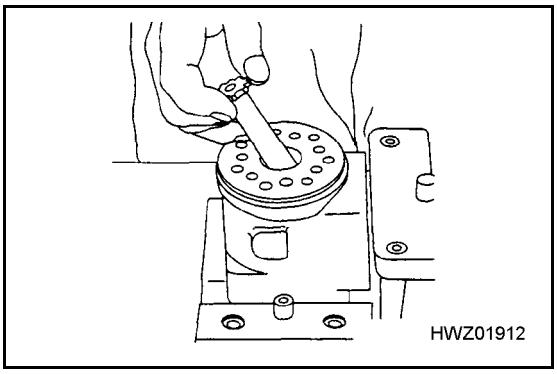
2) Remove the end cover sideways.



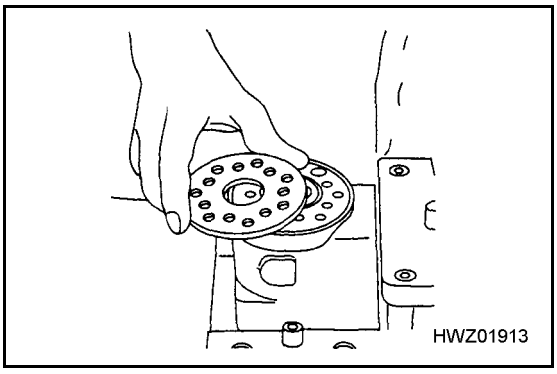
3) Lift the gear wheel set (with spacer, if fitted) off of the unit. Take out the two O-rings.



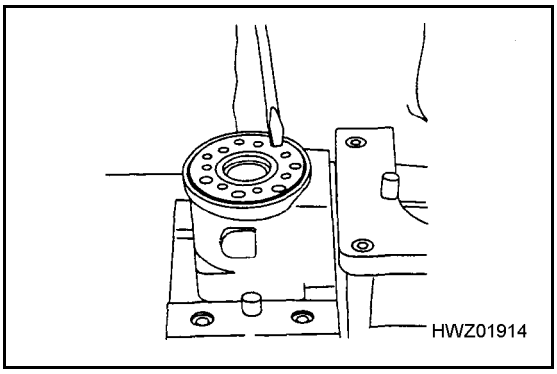
4) Remove the control shaft



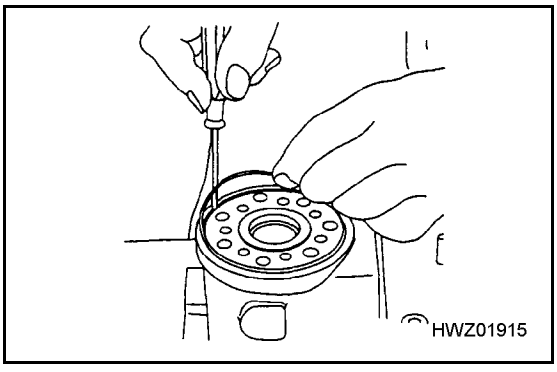
5) Remove the distributor plate



6) Screw out the threaded bushing over the check valve

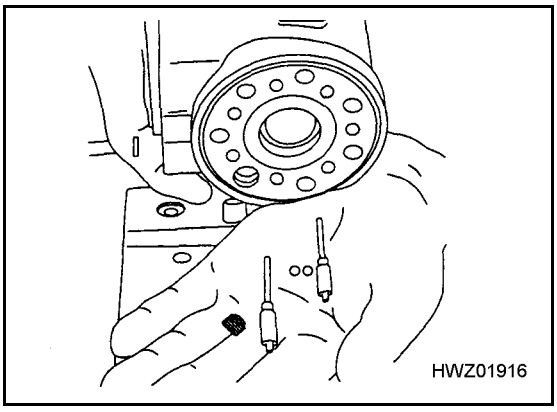


7) Remove O-ring

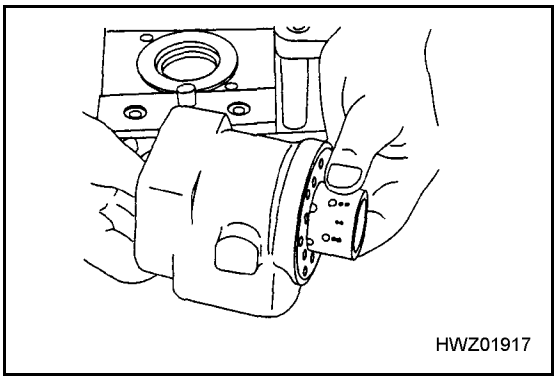


8) OSPC LS; OSPC LSR:
Shake out the check valve ball and suction valve pins and balls

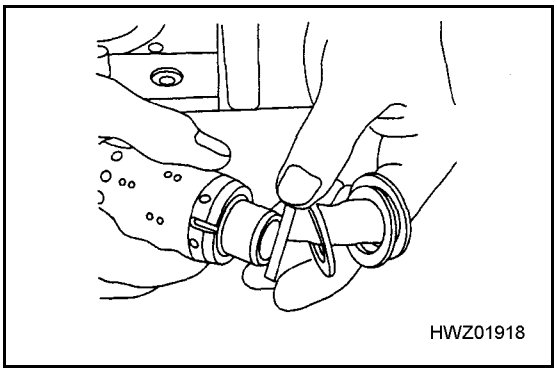
NOTE: Pins and small balls shown in Figure are not included in the unit.



9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.

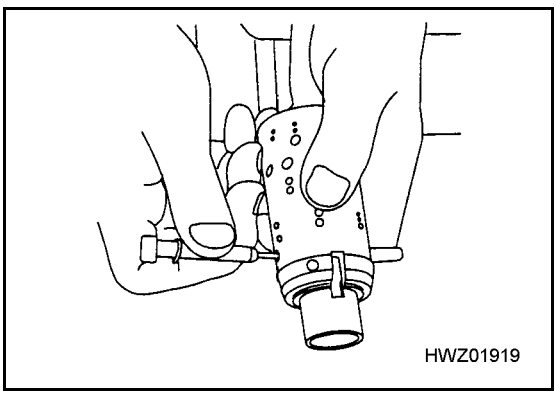


10) Take ring, bearing races and needle bearing from sleeve and spool. The outer (thin) bearing race can sometimes ‘stick’ in the housing so check that it has come out.

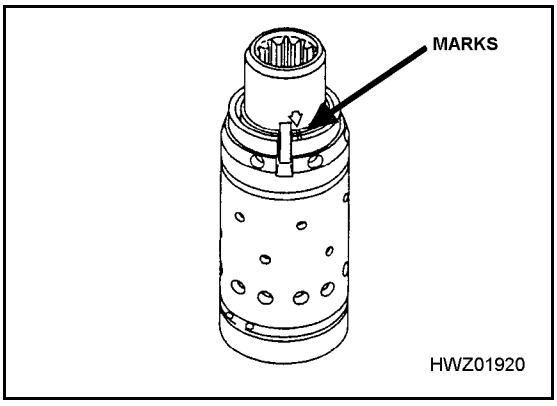


11) Press out the cross pin. Use the special screw from the end cover.

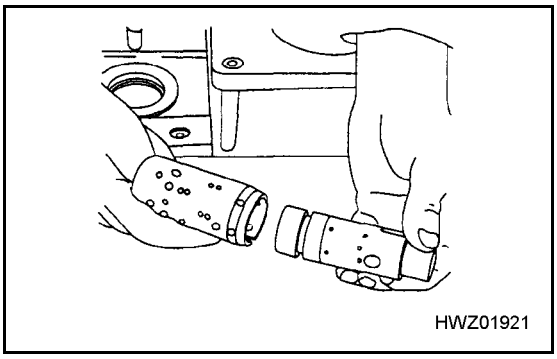
NOTE: See Figure 11a) on next page.



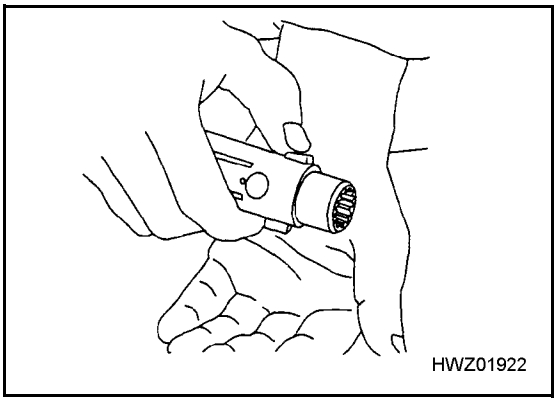
11a) A small mark has been made with a pumice stone on both the spool and the sleeve near one of the slots for the neutral position springs (see Figure)
If the mark is not visible, be sure to make a mark on the sleeve and spool **BEFORE** the neutral position springs are dismantled.



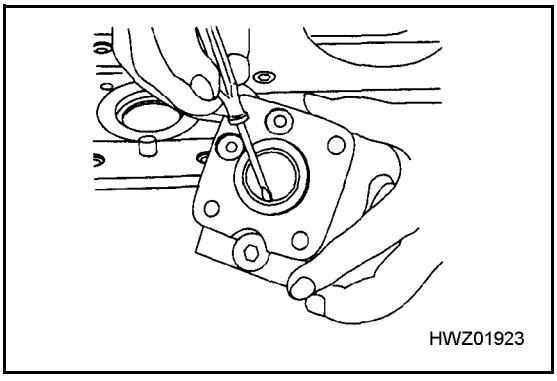
12) Carefully press the spool out of the sleeve.



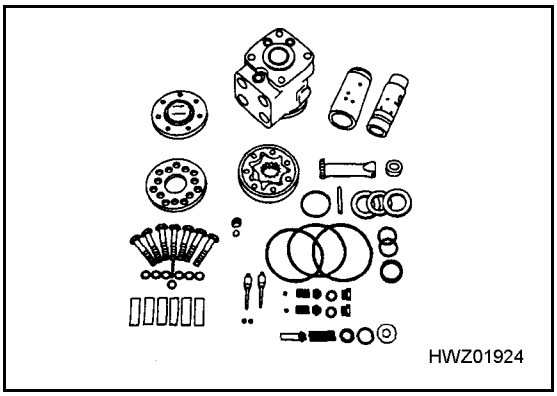
13) Press the neutral position springs out of their slots in the spool.



14) Remove the dust seal and O-ring / seal ring.



15) The steering unit OSPC is now completely disassembled.
The Figure shows a few extra parts to add other functions.


HWZ01924

Cleaning
Clean all parts carefully in Shellsol K or similar cleaning medium.

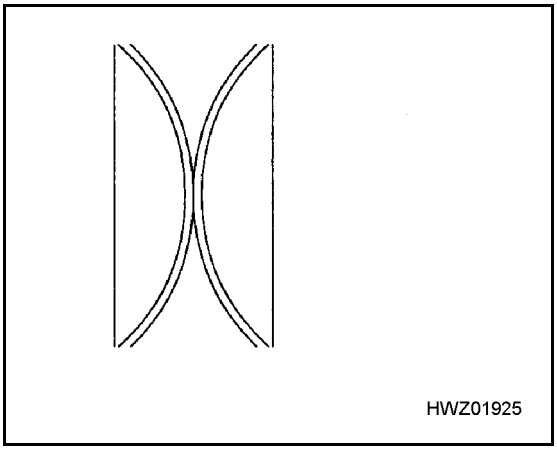
Inspection and replacement
Replace all seals and washers. Check all parts carefully and make any necessary replacements.

Lubrication
Before assembly, lubricate all parts with hydraulic oil.

ASSEMBLY PATTERN AND COLOR CODE FOR NEUTRAL POSITION SPRINGS

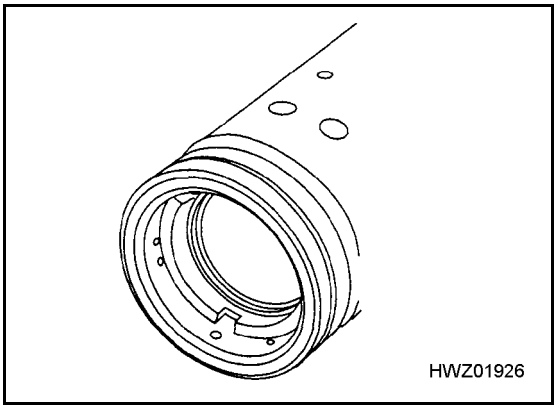
Standard springs (gray)
2 are flat, gray: Code No. DF150N0628
4 are curved, gray: Code No. DF150-0721

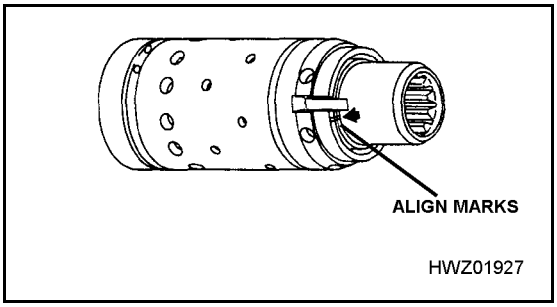
Gray set
Spare set: Code No. DF150N4019


HWZ01925

ASSEMBLY

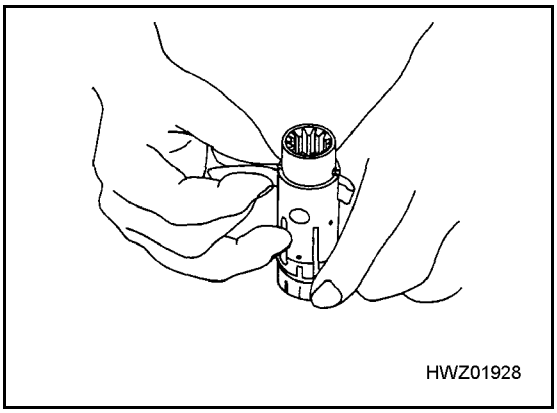
1) Assemble spool and sleeve
   NOTE: Assemble the spool/sleeve and make sure the marks on spool and sleeve match up together (See Figure)


HWZ01926

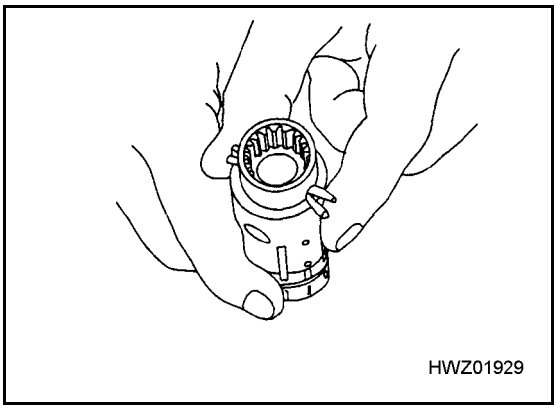


HWZ01927

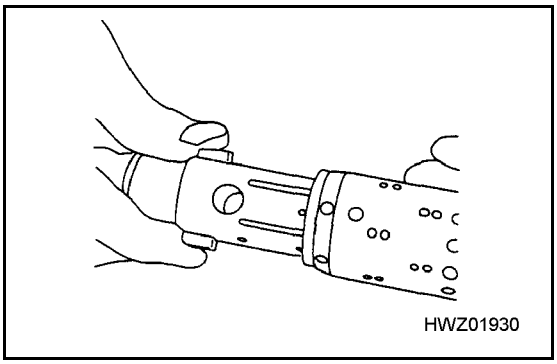
2) Place the two flat neutral position springs in the slot.
   Place the curved springs between the flat ones. Press them into place (See “Assembly Pattern” on previous page).


HWZ01928

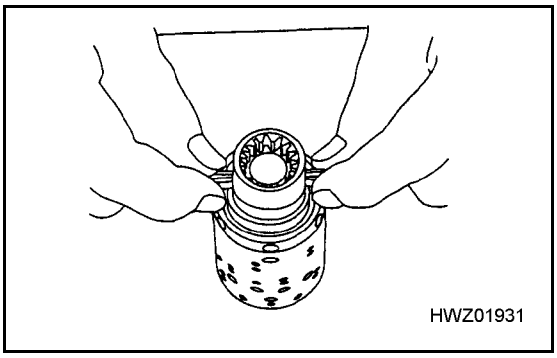
3) Line up the spring set.


HWZ01929

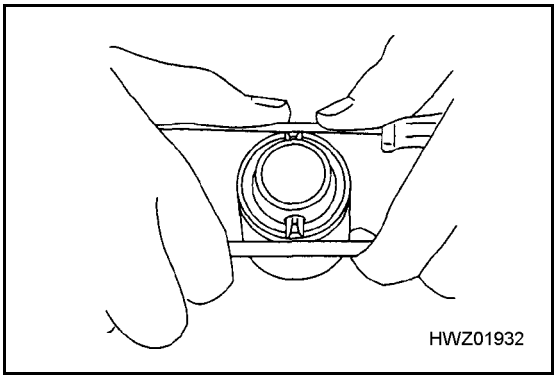
4) Guide the spool into the sleeve



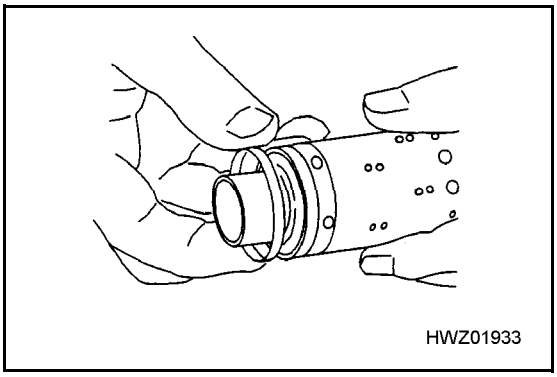
5) Press the springs together and push the neutral position springs into place in the sleeve.



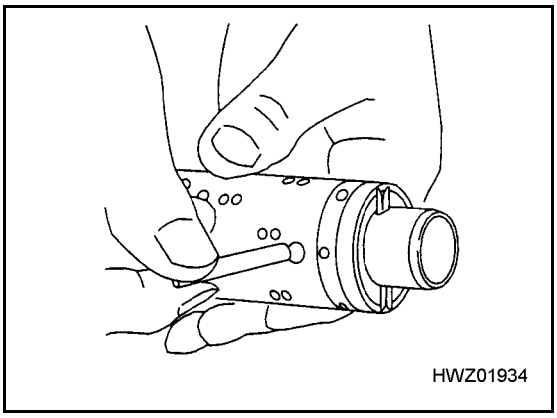
6) Line up the springs and center them.



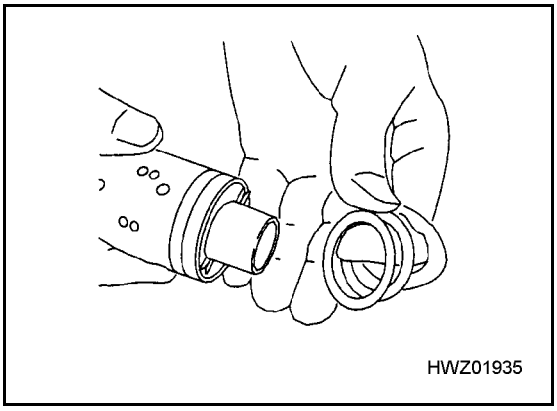
7) Guide the ring down over the sleeve.
NOTE: The ring should be able to rotate free of the springs.



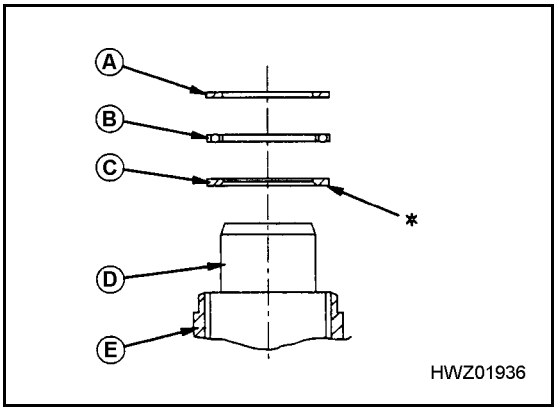
8) Fit the cross pin into the spool/sleeve.



9) Fit bearing races and needle bearing as shown in Figure at below-right.



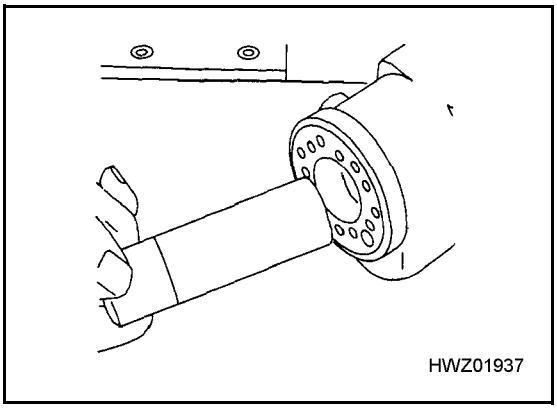
Assembly pattern for standard bearings:
A) Outer bearing race
B) Needle bearing
C) Inner bearing race
D) Spool
E) Sleeve



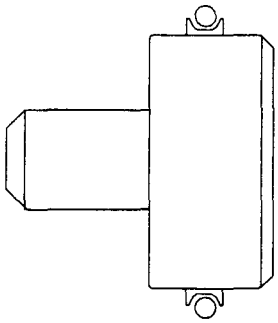
INSTALLATION INSTRUCTIONS FOR THE O-RING AND SEAL RING (STANDARD)

NOTE: The inside chamfer on the inner bearing race must face the inner spool.

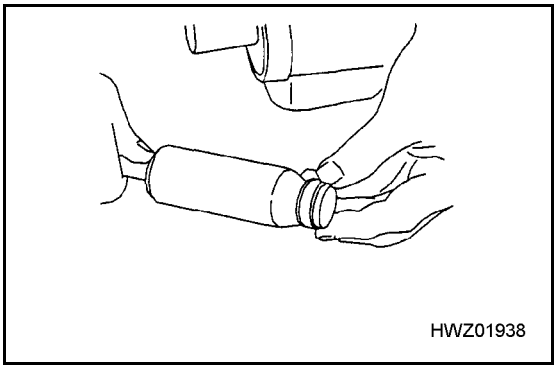
10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool/sleeve.



11) Grease O-ring and seal ring with hydraulic oil and place them on the tool.

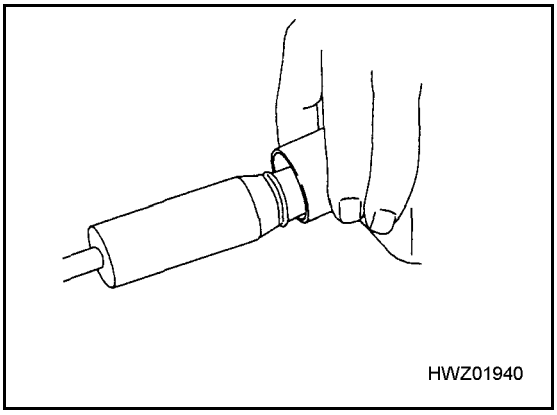


HWZ01939



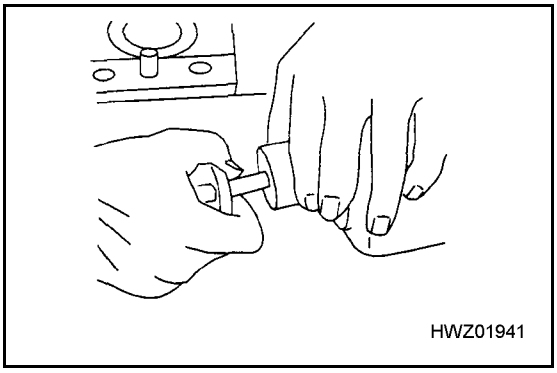
HWZ01938

12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool to the bottom.



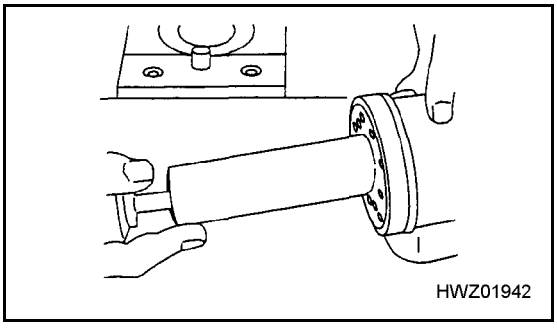
HWZ01940

13) Press and turn the O-ring and seal ring into position in the housing.



HWZ01941

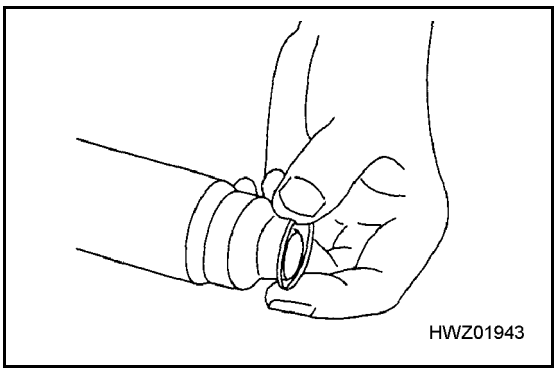
14) Draw the inner and outer parts of the assembly tool out of the steering unit bore leaving the guide from the inner part in the bore.

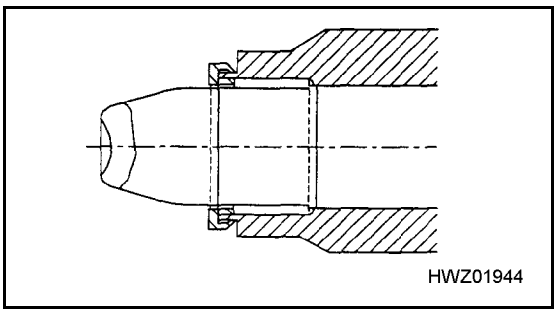


HWZ01942

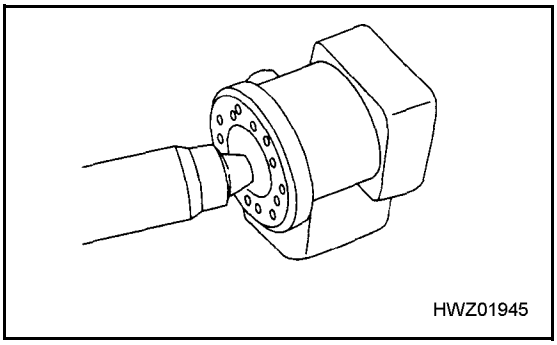
INSTALLATION INSTRUCTIONS FOR THE LIP SEAL

15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.

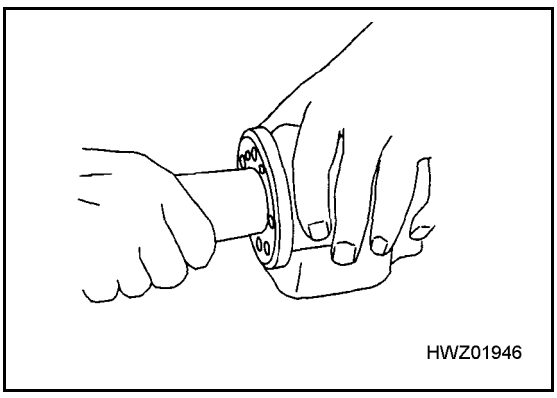

HWZ01943


HWZ01944

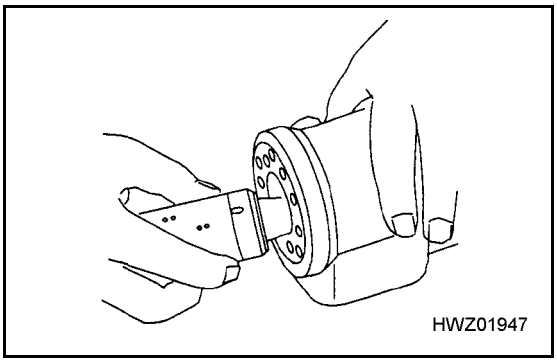
16) Guide the assembly tool fully to the bottom.


HWZ01945

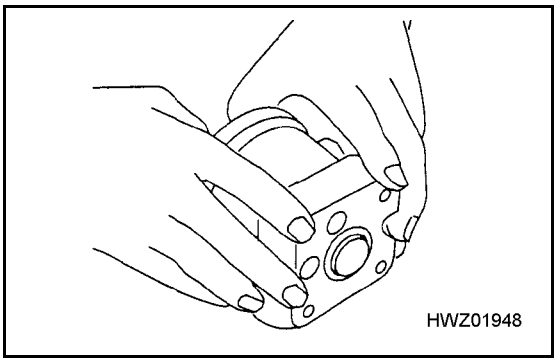
17) Press and turn the lip seal into place in the housing.


HWZ01946

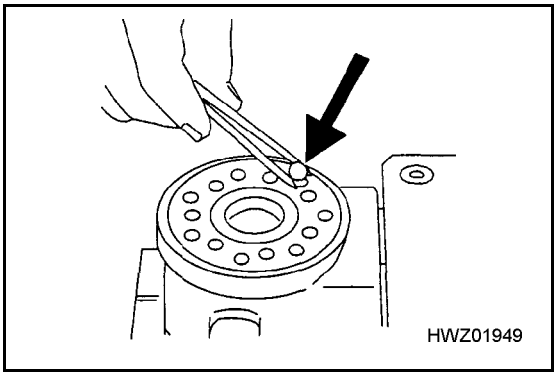
18) With a gentle turning movement, guide the spool and sleeve into the bore.
NOTE: Insert the spool set while holding the cross pin horizontally.



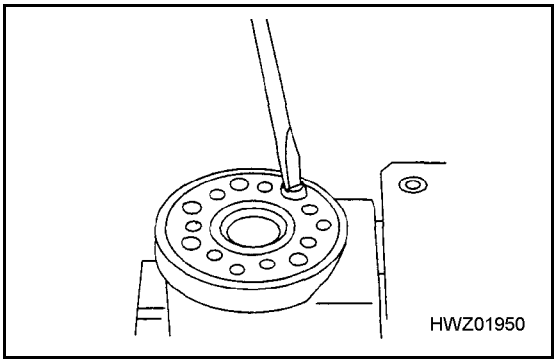
19) The spool set will push out the assembly tool guide. The O-ring and seal ring are now in position.



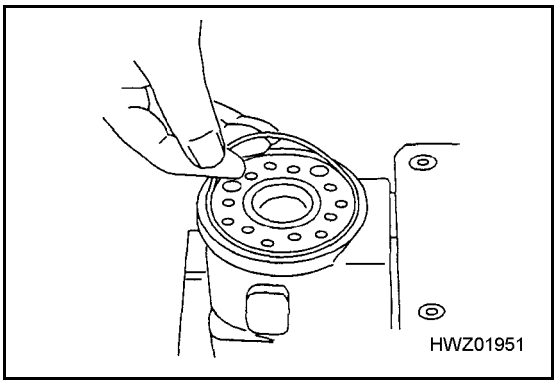
20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole as indicated by the arrow in Figure at right.



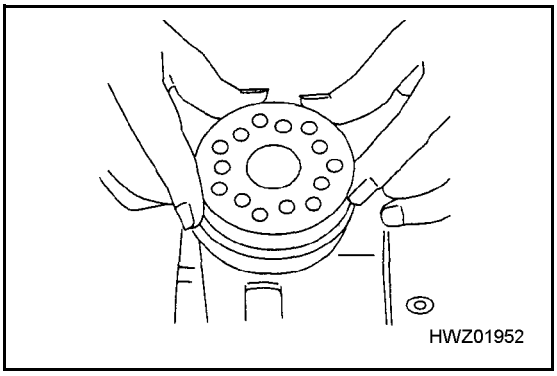
21) Screw the threaded bushing lightly into the check valve bore. The top of the bushing must lie just below the housing surface.



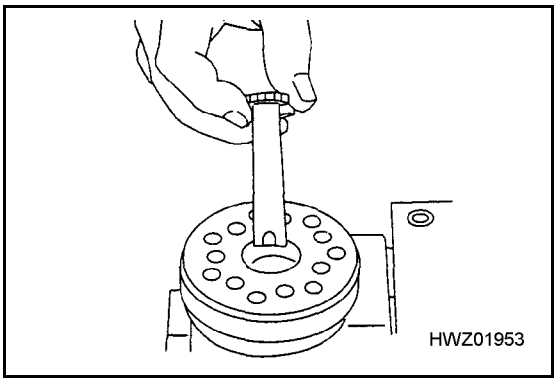
22) Grease the O-ring with clean 10w hydraulic oil.



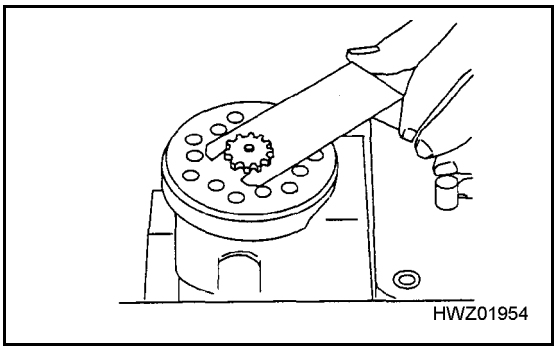
23) Place the distributor plate so that the channel holes match the holes in the housing.



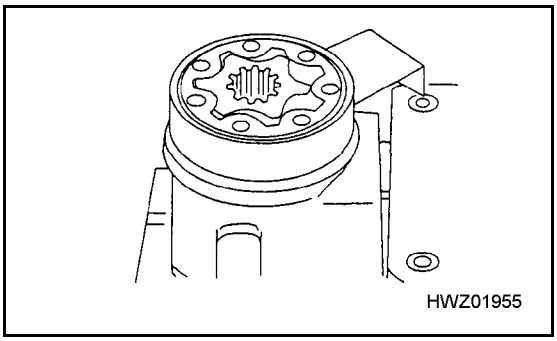
24) Guide the control shaft down into the bore so that the slot is parallel with the connection flange.



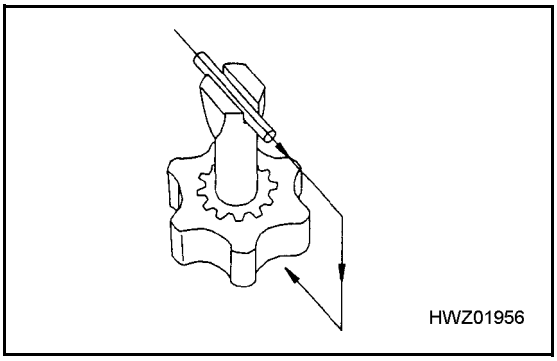
25) Place the control shaft as shown so that it is held in position by the mounting fork.



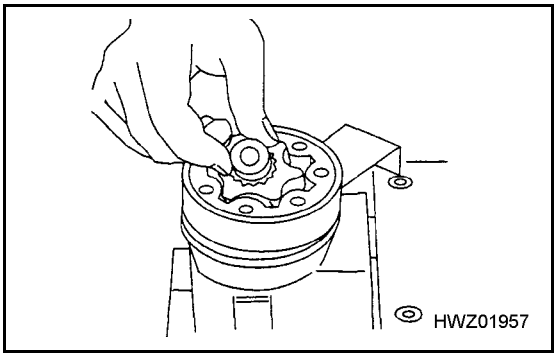
26) Grease the two O-rings with 10w hydraulic oil and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the control shaft.



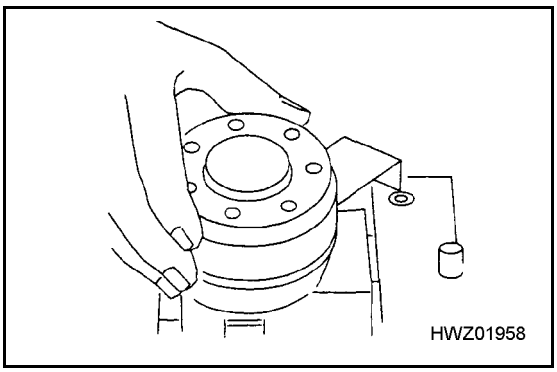
27) **NOTE - IMPORTANT:**
Fit the gearwheel (rotor) and control shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through-holes match the holes in the housing.



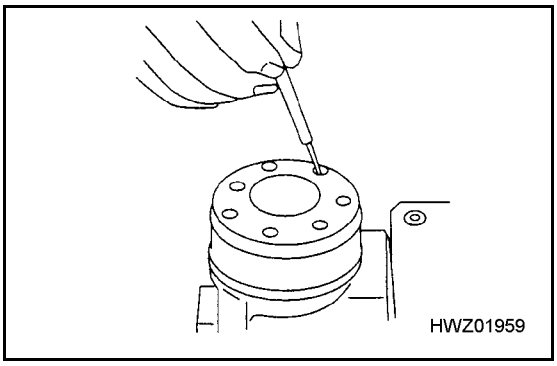
28) Fit the spacer, if any is being used.



29) Place the end cover in position.



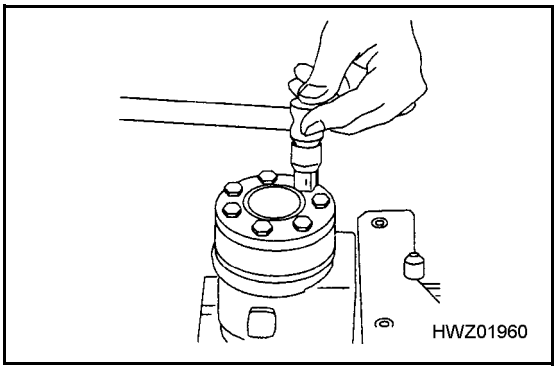
30) Place the washer on the special screw and place in the hole as shown at right.



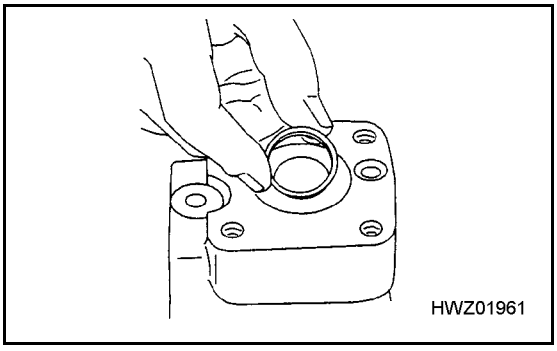
31) Equip the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin with a torque of:

3.0 ± 0.6 Nm (0.31 ± .06 kgfm)
(26.6 ± 5.3 lbin)

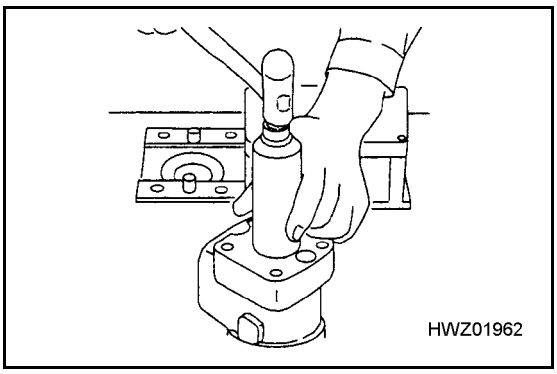
The OSPB, OSPB LS and the OSPBX LS can now be function tested.



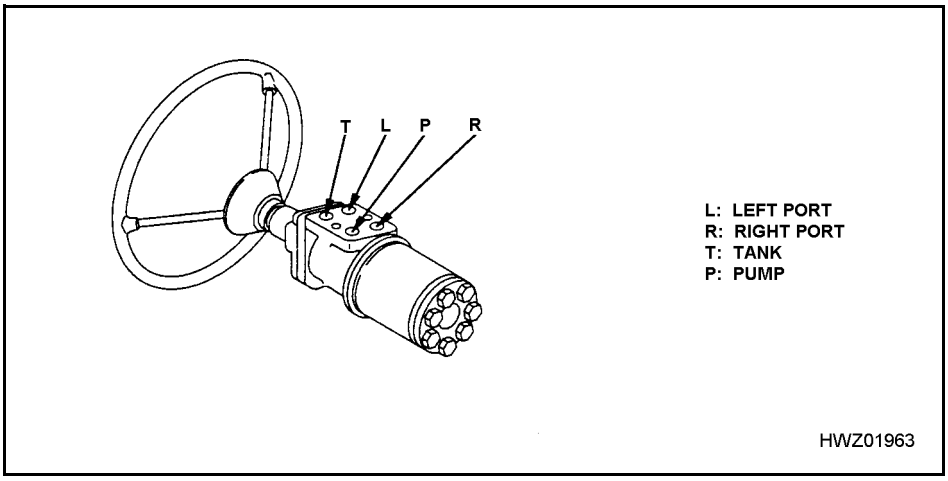
32) Place the dust seal ring in the housing. With the OSPC, PSPC LS and OSPC LSR, the dust seal ring must be placed only **AFTER** the pressure relief valve and shock valves have been fitted.



33) Fit the dust seal ring in the housing using special tool SJ 150-9000-22 and a plastic hammer as shown at right.

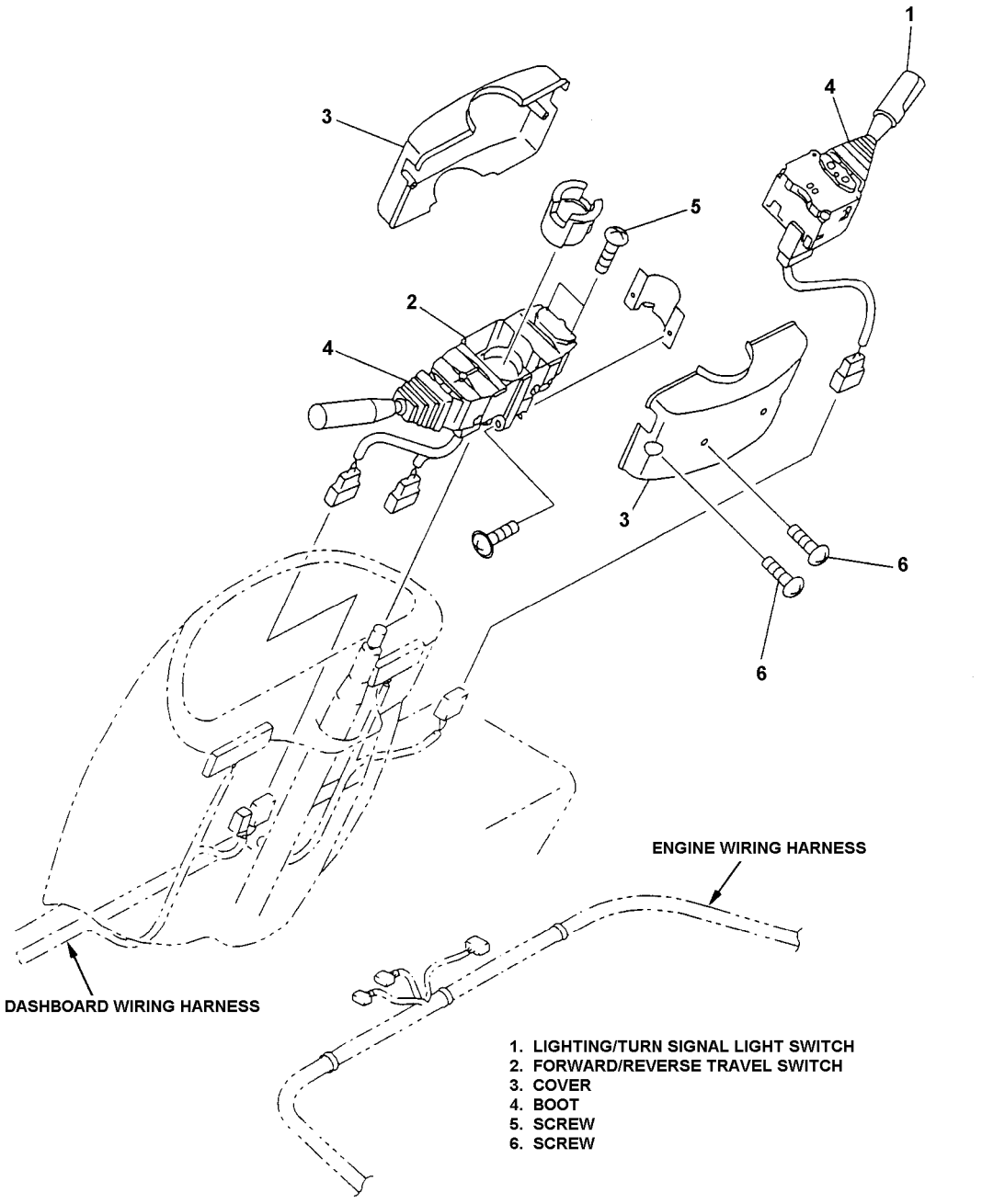


Screwed connection	Maximum tightening torque Nm (lbin)
	With O-ring
3/4 - 16 UNF	6 (530)



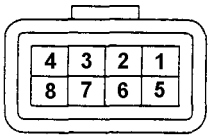
COMBINATION SWITCH

TORQFLOW TRUCK - COMPONENT PARTS

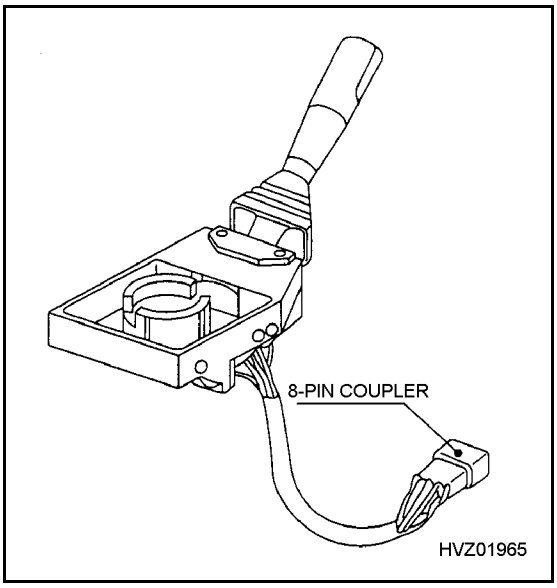


Checking lighting / turn signal switch (Without dimmer switch)

1) Disconnect 8-pin coupling between combination switch cord and wiring harness.
2) Check continuity between terminals at each position, and check that there is continuity between O-O. (See Tables).
3) Insulating resistance: Minimum 10 MΩ at each terminal with 500 V megger.



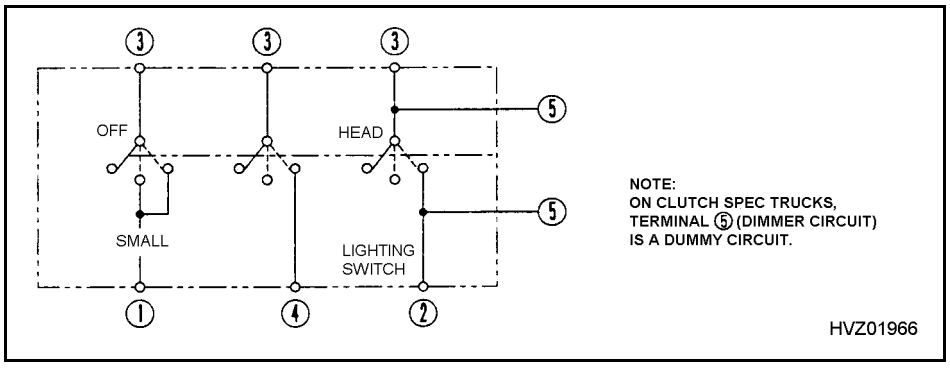
TERMINAL ARRANGEMENT OF 8-PIN COUPLER (COMBINATION SWITCH END)



Connection positions for lighting switch

Position \ Circuit		1	2	3	4
Lighting switch	OFF				
	SMALL	O		O	
	HEAD		O	O	
				O	O

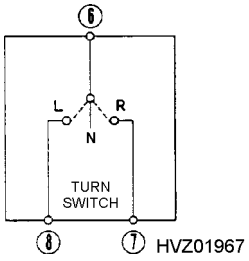
Circuit diagram



Connection positions of turn signal switch

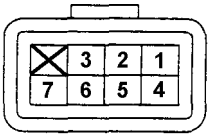
Position \ Circuit	6	7	8
R	O	O	
Intermediate			
L	O		O

Circuit diagram

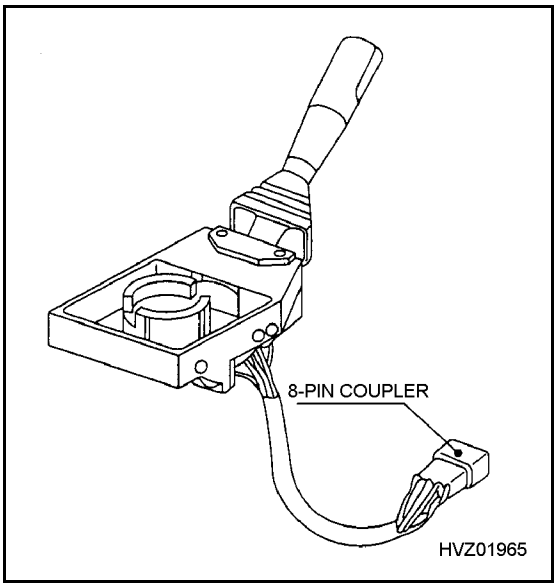


Checking lighting / turn signal switch (With dimmer switch)

1) Remove connection of 8-pin coupler between combination switch cord and wiring harness.
2) Check continuity between terminals at each position, and check that there is continuity between O - O (See Tables).
3) Insulating resistance: Minimum 10MΩ at each terminal with a 500 V megger.



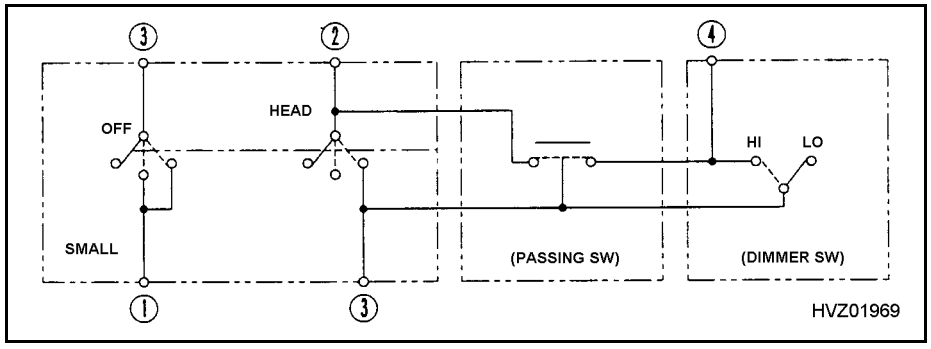
TERMINAL ARRANGEMENT OF 8-PIN COUPLER (COMBINATION SWITCH END)



Connection positions for lighting switch

Position \ Circuit		1	2	3	4
Lighting switch	OFF				
	SMALL	O		O	
	HEAD LO		O	O	
	HEAD HI		O	O	O

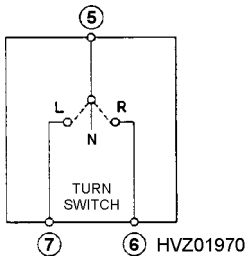
Circuit diagram



Connection positions of turn signal switch

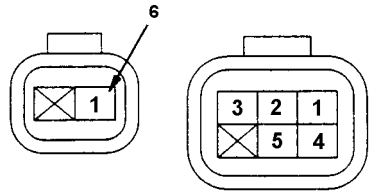
Position \ Circuit	5	6	7
R	O	O	
Intermediate			
L	O		O

Circuit diagram

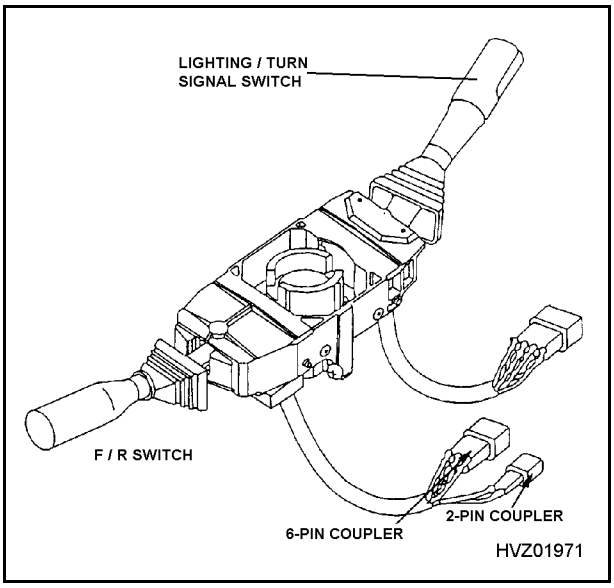


Checking lighting / turn signal switch

1) Remove connection of 8-pin, 6-pin and 2-pin couplers between combination switch cord wiring harness.
2) Check continuity between terminals at each position, and check that there is continuity between O - O (See Tables).
3) Insulating resistance: Minimum 10MΩ at each terminal with 500 V megger.



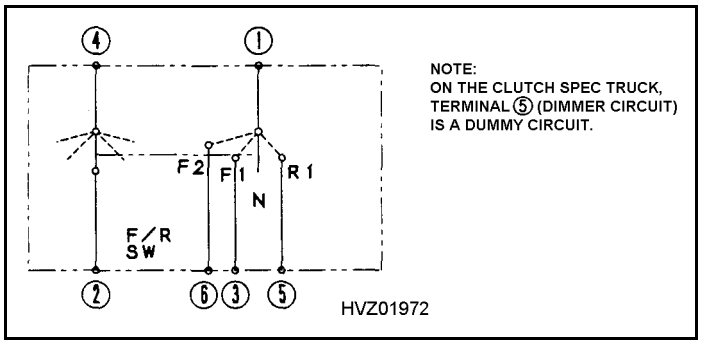
TERMINAL ARRANGEMENT OF 6-PIN AND 2-PIN COUPLERS (COMBINATION SWITCH END)



Connection positions for lighting switch

Position / Circuit		1	2	3	4
Lighting switch	OFF				
	SMALL	O		O	
	HEAD		O	O	
				O	O

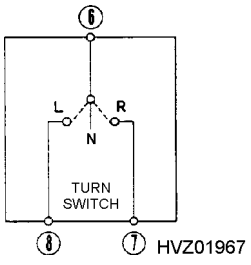
Circuit diagram



Connection positions of turn signal switch

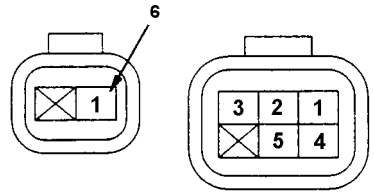
Position / Circuit	6	7	8
R	O	O	
Intermediate			
L	O		O

Circuit diagram

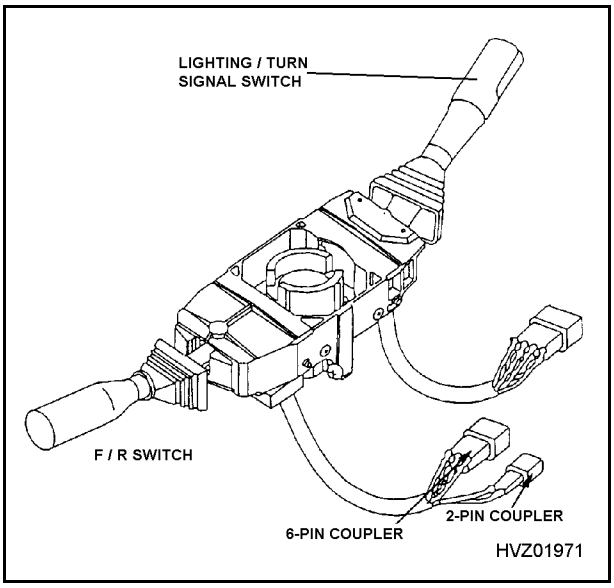


Checking F/R switch

1) Remove connection of 8-pin and 2-pin couplers between combination switch cord and main wiring harness.
2) Check continuity between terminals at each position, and check that there is continuity between O - O only. (See Table below)

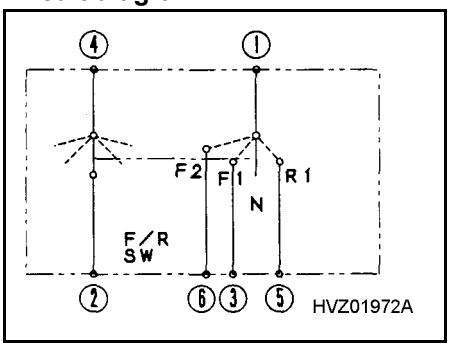


TERMINAL ARRANGEMENT OF 6-PIN AND 2-PIN COUPLERS (COMBINATION SWITCH END)



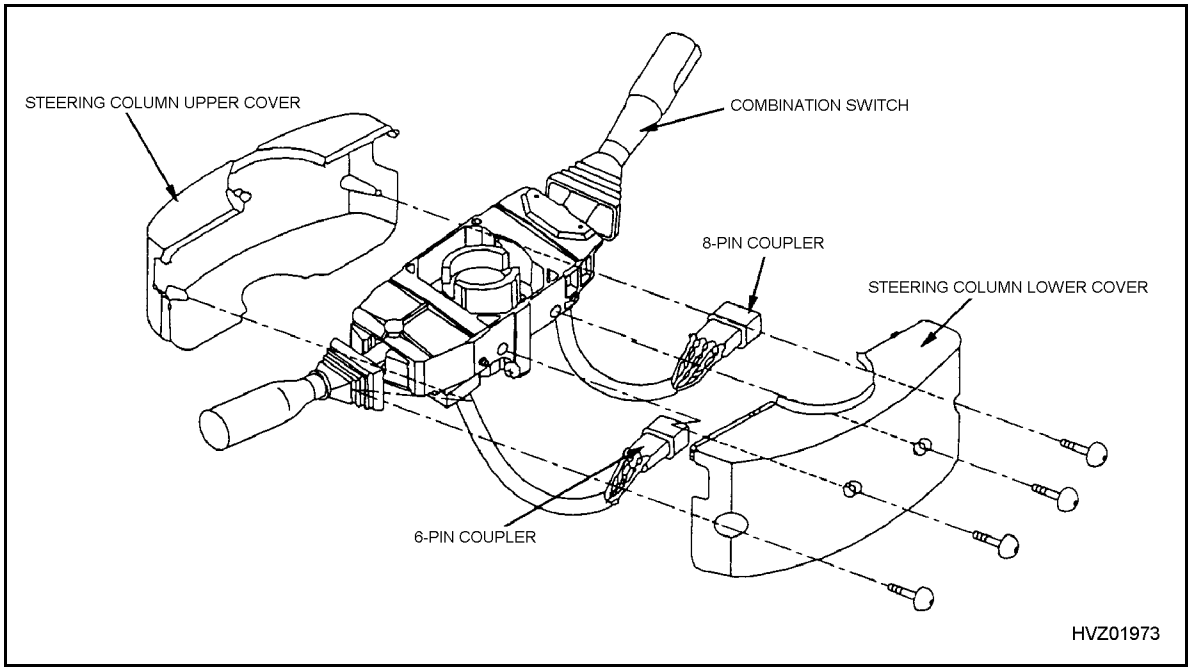
Position	Circuit	1	2	3	4	5	6
F/R switch	Starting motor and N		O		O		
	F1	O		O			
	R1	O				O	
	F2	O					O

Circuit diagram

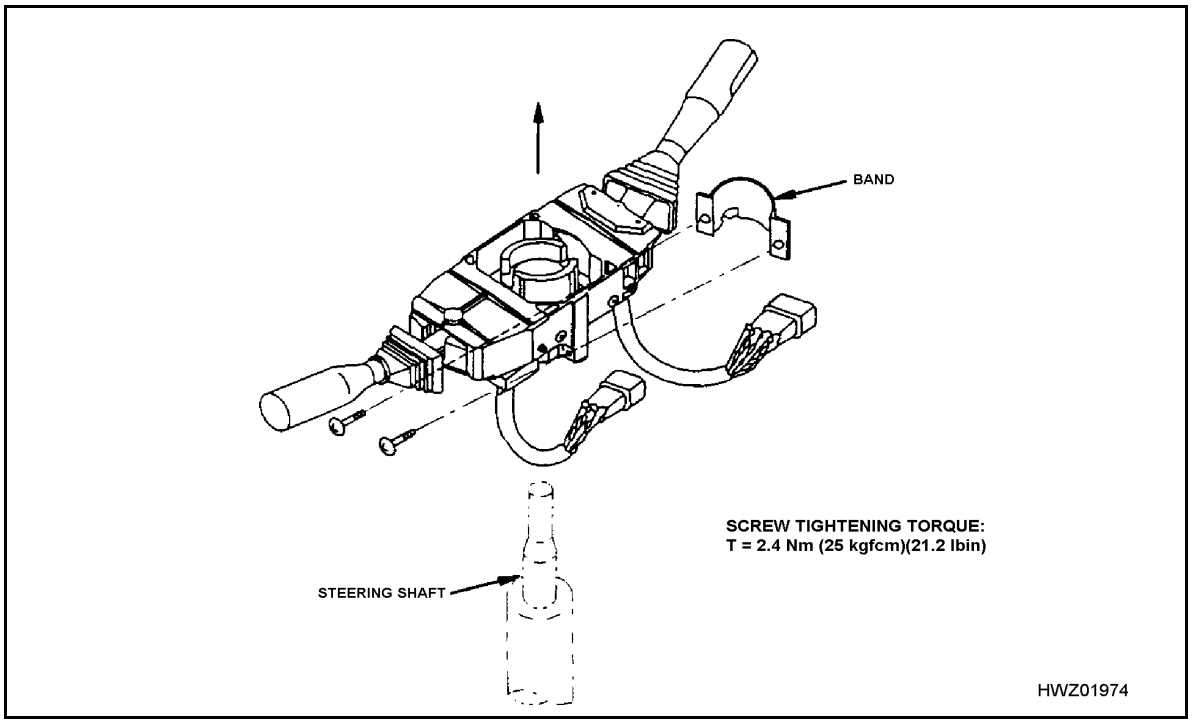


REPLACING COMBINATION SWITCH ASSEMBLY

1) Remove 4 screws and remove steering column upper and lower covers.



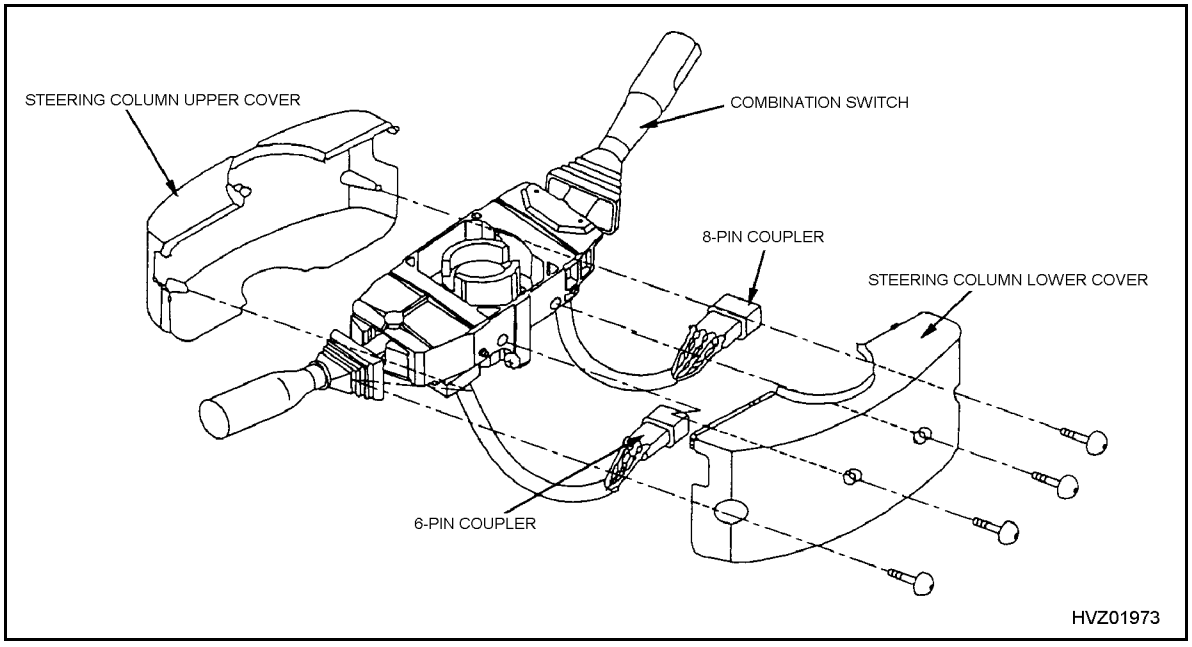
2) Disconnect 8-pin and 6-pin couplers between combination switch cord and main wiring harness (for the F2/R1 truck, also disconnect the 2-pin coupler).
3) Remove 2 band screws holding steering shaft and combination switch and remove switch.



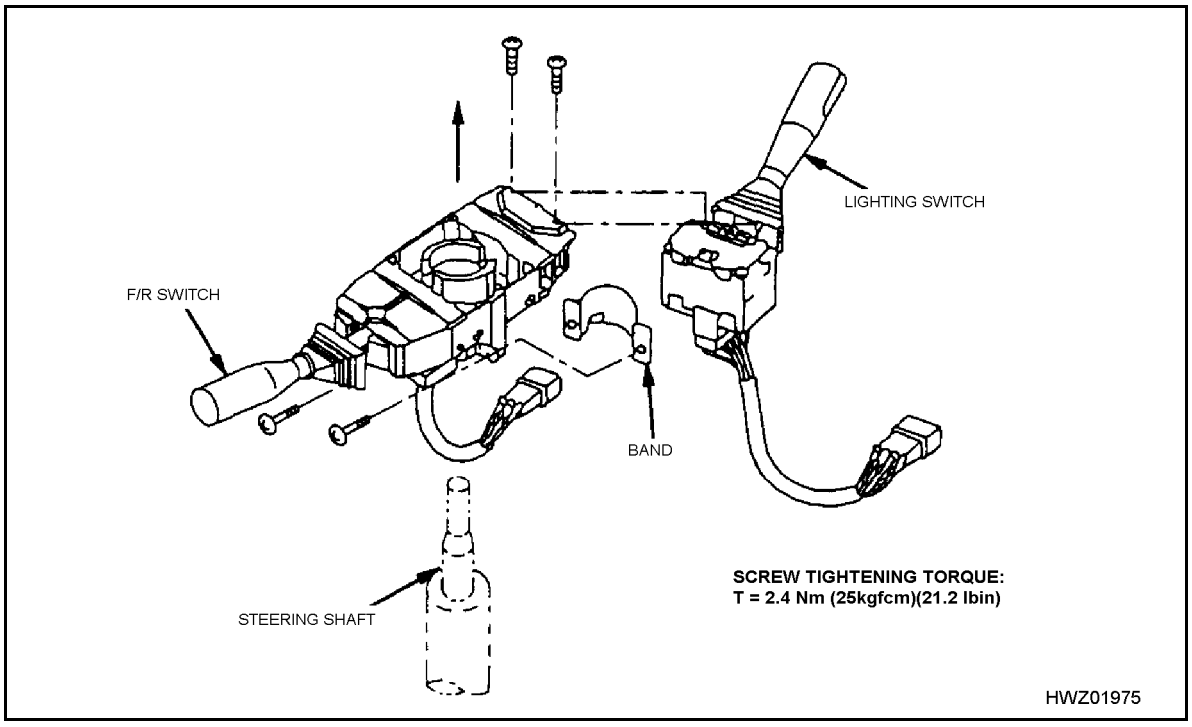
4) Carry out installation in the reverse order of removal.

REPLACING LIGHTING AND F/R SWITCH

1) Remove upper and lower covers from steering column by removing 4 holding screws.

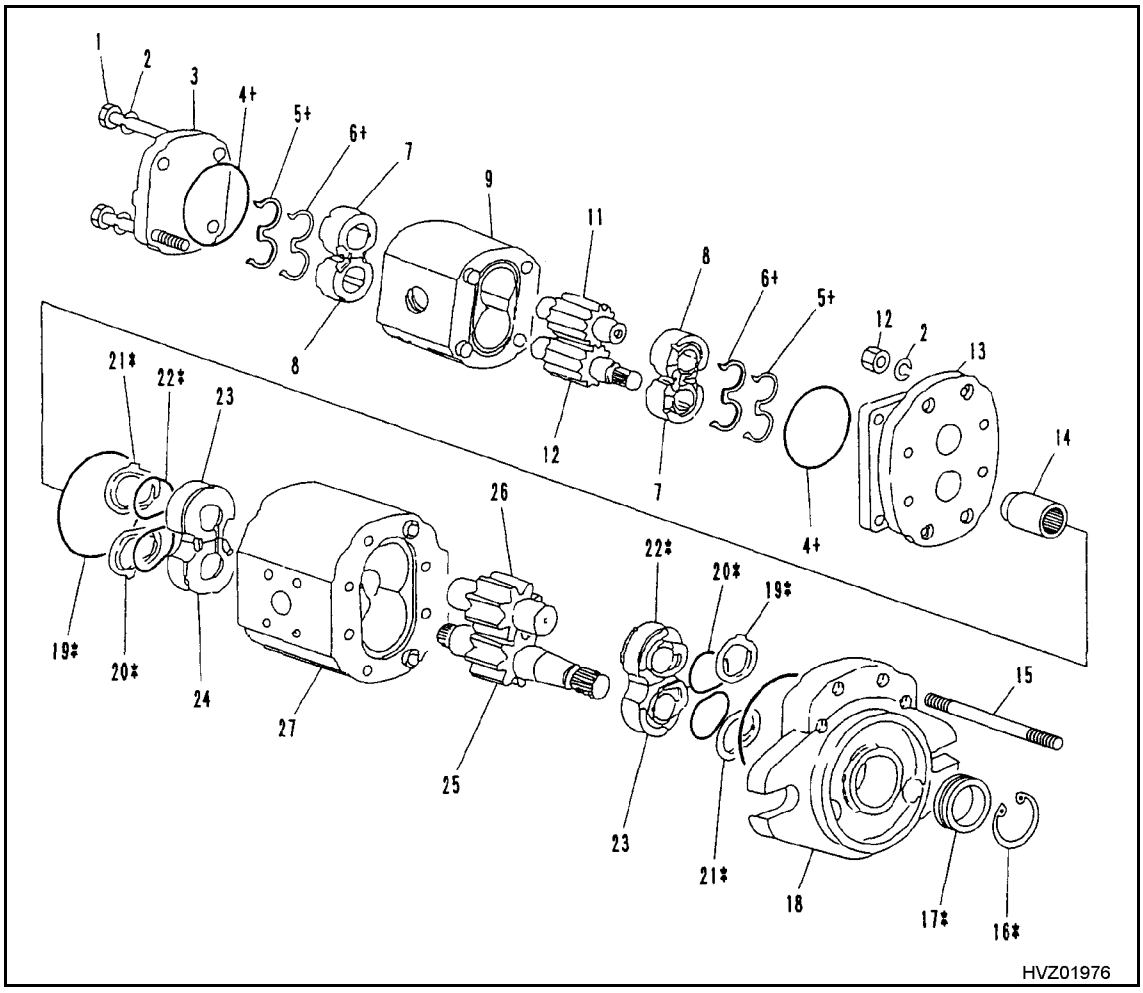


2) Disconnect 8-pin and 6-pin couplers between combination switch cord and main wiring harness.
3) Remove 2 band screws holding steering shaft and combination switch and remove the switch.
4) Remove 2 lighting switch unit mounting screws and cord tightening resin band to remove switch.



4) Carry out installation in the reverse order of removal.

HYDRAULIC PUMP



Item No.	Description	Item No.	Description
1	3/8” - 16 BOLT	15	3/8” - 16 STUD
2	SPLIT WASHER	16*	“C” CLIP
3	CAST IRON COVER	17*	SHAFT SEAL
4*	BODY O-RING	18	ALUMINUM FLANGE
5*	SEAL ELEMENT	19*	BODY O-RING
6*	SEAL ENERGIZER	20*	SEAL ELEMENT
7	BUSH BLOCK	21*	SEAL ELEMENT
8	BUSH BLOCK	22*	SEAL ENERGIZER
9	ALUMINUM BODY	23	BUSH BLOCK
10	DRIVE GEAR	24	BUSH BLOCK
11	DRIVEN GEAR	25	DRIVE GEAR
12	3/8” - 16 NUT	26	DRIVEN GEAR
13	SPACER	27	ALUMINUM BODY
14	QUILL	--	----------

DISMANTLING THE REAR PUMP SECTION

Before starting work, be sure that the unit, work area and all tools are thoroughly clean to prevent contamination of the unit.

1. Lightly mark the end cover, body and spacer (3, 9 & 13) to ensure reassembly in the proper sequence.
2. Remove bolts and spring washers (1 & 2).
3. Remove end cover (3), body, O-ring (4), bush seal and back-up seal (6 & 5).
4. Turn the unit over and lightly tap the spacer (13) to disengage it from the locating dowels.
5. Remove body O-ring (4), bush seal and back-up seal (6 & 5).
6. Before removing the internal components, mark the bushes to denote the location in the body.
   On a clean area away from the seal location mark:
   FD = Bush on driveshaft spacer end
   FI = Bush on driven gear spacer end
   CD = Bush on driveshaft cover end
   CI = Bush on driven gear cover end
7. With the unit lying on its side, hold the driveshaft (12) and pull it squarely out of the body bringing with it the bushes (7 & 8).
8. Remove driven gear (11) and the two remaining bushes.

DISMANTLING THE FRONT PUMP

1. Lightly mark the spacer, body and mounting flange (13, 27 & 18) to ensure reassembly in the proper sequence.
2. Remove nuts and spring washers (12 & 2).
3. Remove spacer (13), body O-ring (19), backing rings (20 & 21) and bush lobe seal (22).
4. Turn the unit over and lightly tap the mounting flange (18) to disengage it from the locating dowels and slide it squarely off of the shaft.
5. Remove body O-ring (19), backing rings (20 & 21) and bush lobe seal (22).
6. Before removing the internal components, mark the bushes to denote the location in the body.
   On a clean area away from the seal location mark:
   FD = Bush on driveshaft flange end
   FI = Bush on driven gear flange end
   CD = Bush on driveshaft spacer end
   CI = Bush on driven gear spacer end
7. With the unit lying on its side, hold the driveshaft (25) and pull it squarely out of the body bringing with it the bushes (23 & 24).
8. Remove driven gear (26) and the two remaining bushes.

REASSEMBLING THE REAR UNIT

Ensure all parts are perfectly clean and lubricate bushings and gears with clean hydraulic fluid (ensure O-ring recess and end faces of body remain dry). This will assist assembly of components into the body bores.

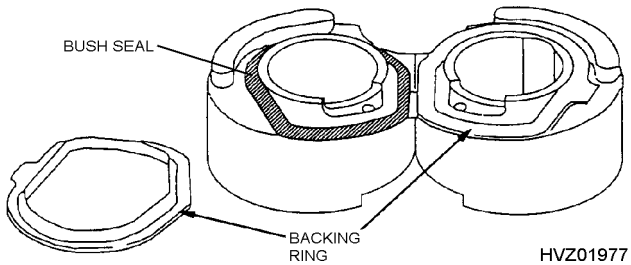
1. Refit cover end bushes (CD & CI) into the undowelled end of the body from where they were removed. The “C” shaped cut-out in the bushes must be located to the side of the body with the cusp removal flat.
2. Place the end cover (3) against the undowelled end of the body (9) and stand the assembly on the cover so the dowels are uppermost and to the left hand side.
3. Fit driveshaft (12) and driven gear (11) into their original positions in the body.
4. Refit spacer end bushes (FD & FI) into their original bores remembering that the “C” cut-out must be to the side of the body with the cusp removal flat and match the cover end bushes.
5. Fit new body O-ring (4) ensuring that the seals locate correctly in the seal grooves.
6. Holding the whole unit together, carefully turn it over onto spacer and engage driveshaft into quill (14).
7. Remove end cover (3) and fit new body O-ring (4), bush seals and back-up seals (5 & 6).
8. Replace the end cover and refit bolts and spring washers (1 & 2). Torque bolts to 46-51 Nm (34 - 37.6 lbft).
9. Pour a small amount of clean hydraulic fluid into a port and check that the shaft can be rotated without undue force using a smooth jawed vice on the front pump’s driveshaft.

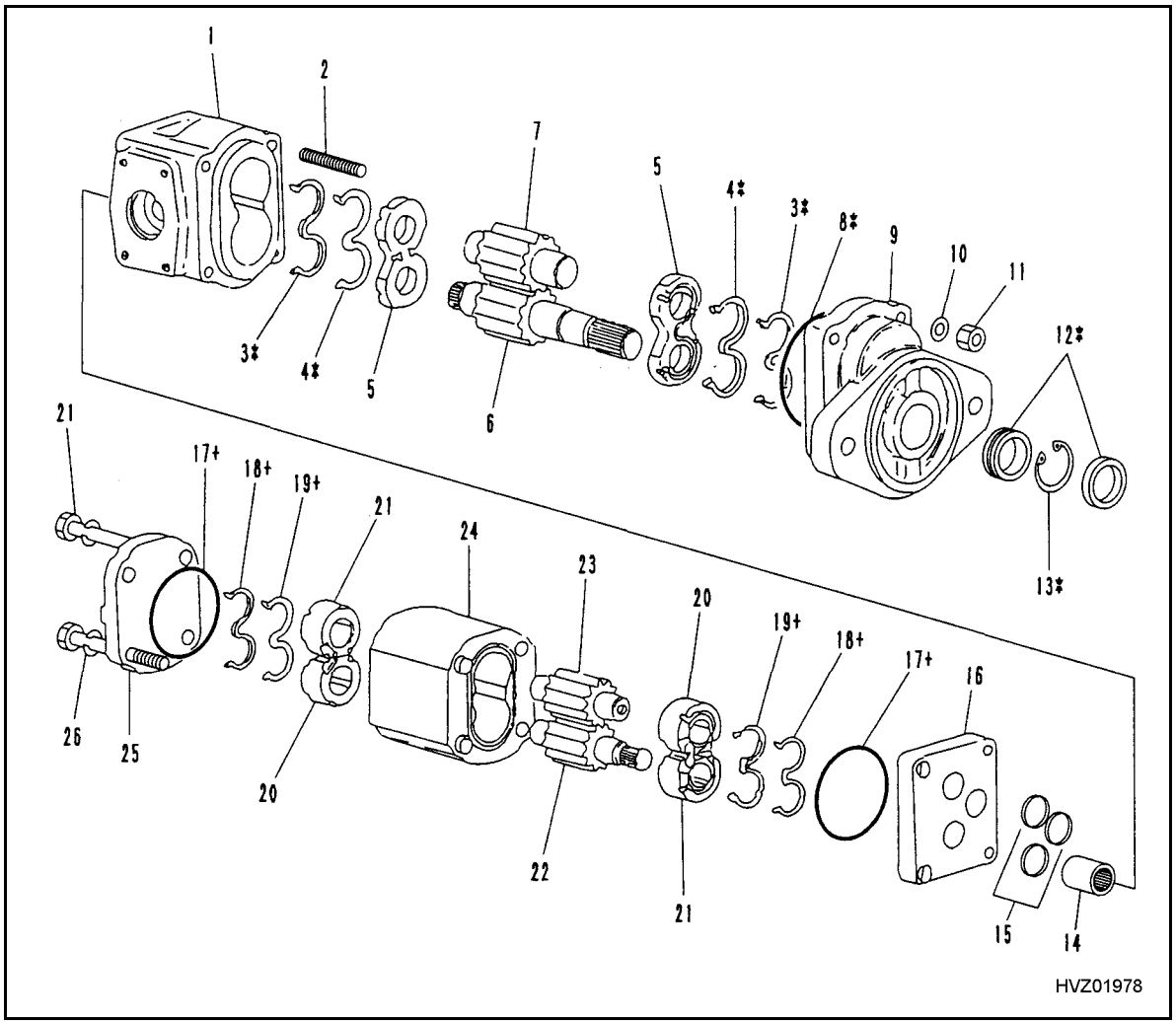
REASSEMBLING THE FRONT UNIT

Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid (ensure O-ring recess and end faces of body remain dry). This will assist assembly of components into the body bores.

1. Refit spacer end bushes (CD & CI) into the undowelled end of the body from where they were removed. The “C” shaped cut-out in the bushes must be to the side of the body with the cusp removal flat.
2. Place the spacer (13) against the undowelled end of the body (27) and stand the assembly on the cover of the rear pump so the dowels are uppermost and to the left hand side.
3. Fit driveshaft (25) and driven gear (26) into their original positions in the body.
4. Refit flange end bushes (FD & FI) into their original bores remembering that the “C” cut-out must be to the side of the body with the cusp removal flat and match the cover end bushes.
5. Fit new body O-ring (19). backing rings (20 & 21) and bush lobe seal (22), ensuring that the seals locate correctly in the seal grooves. See Figure below.
6. Push shaft seal (17) squarely into the recess in the mounting flange (18) with the garter spring facing in towards the pump. Then fit the C-clip (16).
7. Holding the whole unit together, carefully turn it over, making sure it is supported on the mounting flange (18) and not the shaft.
8. Remove spacer (13) and fit new body O-ring (19), backing rings (20 & 21) and bush lobe seal (22), ensuring that the seals locate correctly in the seal grooves. See Figure below.
9. Replace the spacer and rear pump assembly. Refit nuts and spring washers (12 & 2). Torque bolts to 46 - 51 Nm (34 - 37.6 lbft).
10. Pour a small amount of clean hydraulic fluid into a port and check that the shaft can be rotated without undue force.

ASSEMBLING THE BUSH LOBE SEAL AND BACKING RING





Item No.	Description	Item No.	Description
1	CAST IRON COVER	15	O-RING
2	M12 STUD	16	SPACER
3*	SEAL ELEMENT	17*	BODY O-RING
4*	SEAL ENERGIZER	18*	SEAL ELEMENT
5	BUSH PLATE	19*	SEAL ENERGIZER
6	DRIVE GEAR	20	BUSH BLOCK
7	DRIVEN GEAR	21	BUSH BLOCK
8*	BODY O-RING	22	DRIVE GEAR
9	CAST IRON FLANGE	23	DRIVEN GEAR
10	SERRATED WASHER	24	ALUMINUM BODY
11	HEX NUT	25	CAST IRON COVER
12*	SHAFT SEAL	26	SPLIT WASHER
13*	C CLIP	27	3/8” - 19 BOLT
14	QUILL	--	----------

DISMANTLING THE REAR PUMP SECTION

Before starting work, ensure that the unit, work area and all tools are thoroughly clean to prevent contamination of the unit.

1. Lightly mark the end cover, body and spacer (25, 24 & 16) to ensure reassembly in the correct sequence.
2. Remove bolts and spring washers (21 & 26).
3. Remove end cover (25), body, O-ring (17), bush seal and back-up seal (18 & 19).
4. Turn the unit over and lightly tap the spacer (16) to disengage it from the locating dowels.
5. Remove body O-ring (17), bush seal and back-up seal (18 & 19).
6. Before removing the internal components, mark the bushes to denote the locations in the body. On a clean area away from seal location, mark:
   FD = Bush on driveshaft spacer end
   FI = Bush on driven gear spacer end
   CD = Bush on driveshaft cover end
   CI = Bush on driven gear cover end
7. With the unit lying on its side, hold the driveshaft (22) and pull it squarely out of the body bringing with it the bushes (21 & 20).
8. Remove driven gear (23) and the two remaining bushes.

DISMANTLING THE FRONT PUMP

1. Lightly mark the spacer, body and mounting flange (16, 1 & 9) to ensure reassembly in the proper sequence.
2. Remove nuts and spring washers (11 & 10).
3. Turn the unit over and lightly tap the mounting flange (9) to disengage it from the locating pilot and slide it squarely off the shaft.
4. Remove body O-ring (8), bush seal and back-up seal (3 & 4).
5. With the unit lying on its side, hold the driveshaft (6) and pull it squarely out of the body bringing with it the bushes (5).
6. Remove driven gear (7) and the other remaining bush plate (5).

REASSEMBLING THE REAR UNIT

Ensure that all parts are perfectly clean. Lubricate bushes and gears with clean hydraulic fluid (ensure O-ring recess and end faces of body remain dry). This will assist assembly of components into the body bores.

1. Refit cover end bushes (CD & CI) into the undowelled end of the body from where they were removed. The “C” shaped cut-out in the bushes must be to the side of the body with the cusp removal flat.
2. Place the end cover (25) against the undowelled end of the body (24) and stand the assembly on the cover so the dowels are uppermost and to the left hand side.
3. Fit driveshaft (22) and driven gear (23) into their original positions in the body.
4. Refit spacer end bushes (FD & FI) into their original bores remembering that the “C” cut-out must be to the side of the body with the cusp removal flat and match the cover end bushes.
5. Fit new body O-ring (17), bush seal and back-up seal (18 & 19) ensuring that the seals locate correctly in the seal grooves.
6. Fit O-rings (15) to the rear of front pump and place spacer (16) over seals.
7. Holding the whole unit together, carefully turn it over onto spacer and engage driveshaft (22) into quill (14).
8. Remove end cover (25) and fit new body O-ring (17), bush seals and back-up seals (18 & 19).
9. Replace the end cover and refit bolts and spring washers (21 & 26). Torque bolts to 46 - 51 Nm (34 - 37.6 lbft).
10. Pour a small amount of clean hydraulic fluid into a port and check that the shaft can be rotated without undue force using a smooth-jawed vice on the front pump’s drive shaft.

REASSEMBLING THE FRONT UNIT

Ensure that all parts are perfectly clean. Lubricate bushes and gears with clean hydraulic fluid (ensure O-ring recess and end faces of body remain dry). This will assist assembly of components into the body bores.

1. Stand pump body on the rear face, fit seal (3) and back-up (4) to groove in bush plate (5) and feed plate into bore. Ensure that the seals remain in their groove and that the two small holes in the bush plate (5) are to the low pressure side of the pump.
2. Fit driveshaft (6) and driven gear (7) into their original positions in the body.
3. Replace 2nd balance plate (5) into its original position with small holes to the low pressure side of the pump. Fit seal and back-up (3 & 4).
4. Fit new body O-ring (8) into its groove in mounting flange and apply a small amount of Loctite sealant to body lower front face outboard of oval location. This sealant is to prevent moisture from entering this area and causing corrosion. It is not a hydraulic seal.
5. Fit the first shaft seal (12) into mounting flange (9) bore with garter spring facing into the pump. Fit the C-clip (13) in mounting flange (9) groove and then fit 2nd shaft seal (12) into mounting flange (9) bore with garter spring facing out.
6. Carefully fit mounting flange in its original position. The 4mm diameter drain hole in the rear face must be to the low pressure side of the pump. Use caution not to damage shaft seals (12) on shaft.
7. Fit serrated washers and nuts (10 & 11) to studs and tighten to 90 - 95 Nm (65 - 70 lbft).
8. Pour a small amount of clean hydraulic fluid into a port and check that the shaft can be rotated without undue force using a smooth-jawed vice.

INSPECTION AND REPAIR

Each component should be thoroughly cleaned, carefully examined and checked to see if it is reusable. Read the following guide for information on inspecting the various components.

Body

Inspect the body bore cut-in where gears may wipe into the body.

The body can only be reused if the cut-in is bright and polished in appearance and the depth does not exceed .08mm.

The body should be replaced if the surface is scored, has a matte appearance or shows signs that the tip of the gears have dug in and torn away some of the surface material.

The body should be inspected to ensure that there is no superficial damage which may adversely affect performance or sealing. Pay particular attention to the port threads and body O-ring seal recesses.

End cover

The inner surfaces should be inspected to ensure that there is no unusual wear or scoring in the regions where the body O-rings and bush seals contact that may cause external leakage.

Bushes

The side faces, that abut the gears, should be perfectly flat showing no signs of scoring. There are normally light polished areas on this surface caused by loading against the gear side faces, which is often more pronounced on the low pressure side. These should be replaced if there is any general scoring or fine scoring with a matte appearance or tearing of the surface material. Often there is evidence of this where the tips of the opposing gears have wiped an overlap pattern resembling a half-moon shape. There must be no noticeable wear step as it is critical that the bush side face is completely flat to the gear side face.

The bush bearing liners are acceptable providing they are not scored or show other damage. The general outside area of the bush should not show any prominent signs of wear.

Gears

The gear side faces should be examined for bruising or scoring. Often operation with contaminated fluid shows signs of scoring between the root of the gear and the journal, which leaves a wear step. If a wear step can be felt, coincidental with the root diameter, by drawing a sharp pointed tool across the surface from the journal outwards to the tip of the gear, then the gear is unserviceable.

The gear teeth should then be carefully examined to ensure that there are no signs of pitting.

The journal bearing surfaces should be completely free from scoring or bruising. The surface should be free of scoring or bruising also. The surface should appear highly polished and smooth to the touch.

Examine the area where the shaft seal lips run against the driveshaft. This area displays a polished ring or rings. If a noticeable groove can be felt, or there is scoring, the shaft should be replaced.

Provided the driveshaft is not damaged from the drive coupling and the gears have not been harmed as described above, then the gears can be reused. If, however, the gears are damaged, they must be replaced as a matched set.

As a matter of good practice, when pumps have been dismantled, all the seals should be replaced. It is most important that only the genuine Ultra seals are used.

PUMP (FRONT) (DIESEL ENGINE LIFT TRUCK)

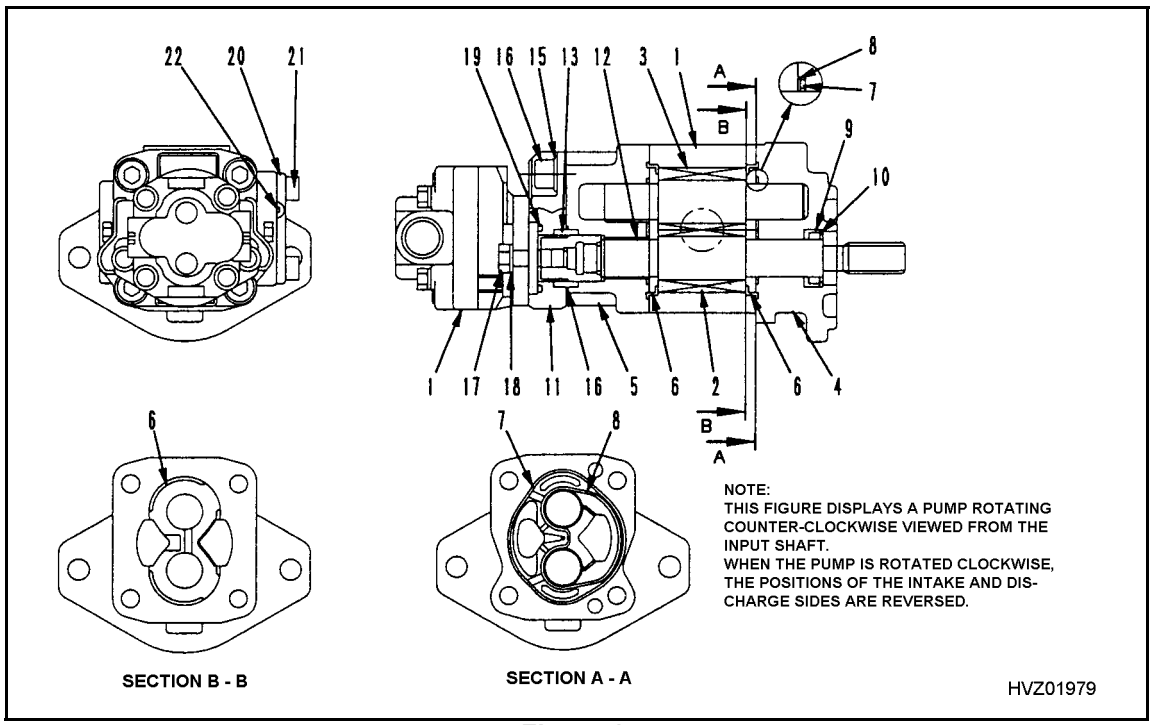


Figure 1.

Item	Description	Qty	Item	Description	Qty
1	Gear plate assembly	1	13	Dowel pin	1
2	Front drive gear	1	14	Socket head bolt	4
3	Driven gear	1	15	Flat washer	4
4	Mounting flange A	1	16	O-ring	1
5	Cover plate A	1	17	Hexagon bolt	2
6	Pressure plate	2	18	Washer	2
7	Plate seal	2	19	O-ring	1
8	Backup ring	2	20	Connector cover	1
9	Oil seal	1	21	Socket head bolt	2
10	Snap ring	1	22	O-ring	1
11	Adapter plate	1	23	KP10 assembly	1
12	Spline coupling	1	--	----------	--

DISASSEMBLY OF FRONT PUMP - DIESEL ENGINE LIFT TRUCK (SEE FIGURE 1.)

1. When disassembling, clean the surface of the pump and driveshaft. Care should be taken not to contaminate, scratch or nick the disassembled parts. Place them on a clean paper or cloth. (Place the parts in order so that the proper locations of each part can be identified prior to reassembly).
2. Insert mounting flange (4) into a smooth, padded vise, with the pump mounting surface downwards, and secure it.
3. Remove hexagon bolt (17) and washer (18) to remove rear pump KP10 assembly (23) and O-ring (19).
4. Loosen socket head bolt (14) and remove it together with plain washer (15).
   Remove adapter plate (11), O-ring (16), spline coupling (12) and dowel pin (13).
5. Loosen socket head bolt (21) and remove connector cover (20) and O-ring (22).
   Caution:
   When loosening bolts, gradually apply force to prevent the mounting flange from dislodging from the vise. Use an appropriate tool (wrench) that is not worn.
6. Remove cover plate (5). Remove the cover plate in an axial direction in a straight line. If it is too tight to remove easily, tap it lightly with a wooden hammer in the removal direction.
7. Remove plate seal (7) and back-up ring (8) from the setting surface of cover plate (5).
8. Pull out pressure plate (6). It can be easily pulled out if the shaft of front drive gear (2) and driven gear (3) is slightly raised.
9. Put the set mark on the shaft end face of front drive gear (2) and driven gear (3) and pull out the gear. (Mark with an oil stone or marker).
10. Pull out pressure plate (6) from the bottom of the gear plate assembly. Do not tilt the pressure plate.
    If the pressure plate has been tilted and it cannot be easily removed, hold and insert the spline of the front drive gear into the gear plate and lightly press the higher portion of the pressure plate. The pressure plate should fall back into its original position. Now pull it out without tilting and jamming.
11. Remove gear plate assembly (1) after marking the cover and mounting flange sides with identification (so they can be reassembled in the same orientation).
    Lightly tap around the gear plate assembly with a wooden hammer or the like to pull it up. Since the dowel pin is press fitted into the gear plate, do not remove it.
12. Remove plate seal (7) and back-up (8) from mounting flange (4). Remove snap ring (10) to remove oil seal (9). Tap out the oil seal from the inside using a blunted screwdriver or similar tool. Use care not to damage the oil seal press fitting hole and bearing hole.

INSPECTION AND REPAIR PROCEDURES

Check the disassembled parts for contamination or discoloration and then clean them with diesel oil. DO NOT dip rubber parts in diesel oil.
After checking all the parts, as follows, repair or replace any defective parts found.

1. Gear plate assembly (1)
   The gear pump is designed to rotate while the gear teeth tips are making contact in the inner gear hole to improve volumetric efficiency. Therefore, if the pump has been driven once, the evidence of contact of the tooth tips can be seen in the area of the intake port of the pump.
   If the trace of contact is not more than 1/2 of the circumference of the gear pump, it is normal. Approximately 0.05mm is a normal value of the depth of "**a**" in Figure 2. If the depth "**a**" exceeds 0.12mm, wear of the shaft or the bearing is assumed to be excessive. Carefully check these parts.
   If "**a**" equals or exceeds 0.12mm, replace the entire pump assembly with a new unit.
2. Front drive gear (2) and driven gear (3)
   If hydraulic oil is clean, the relative roughness of the gear and the side of the gear hardly changes, and it presents a smooth contact surface. If the surface of the gear or the side of the gear is so rough as to show gouges or scoring on the surface, or the surface of the gear teeth is partially or abnormally worn, replace it with a new one.
   See Figure 4. If the diameter of the gear "**d**" is less than 24.895mm, replace with a new gear set.

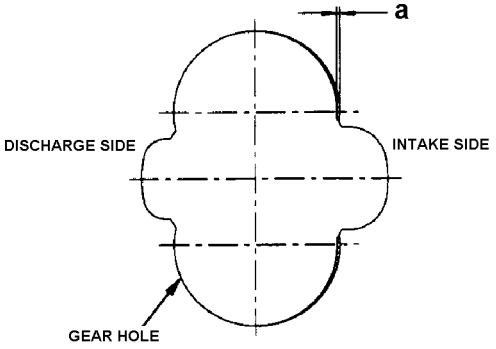


Figure 2. HVZ01980

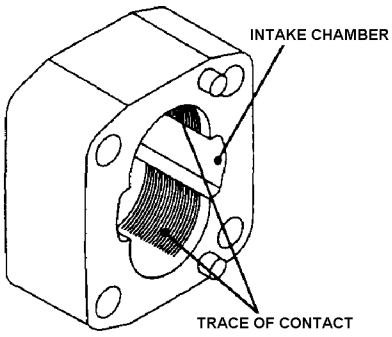


Figure 3. HVZ01981

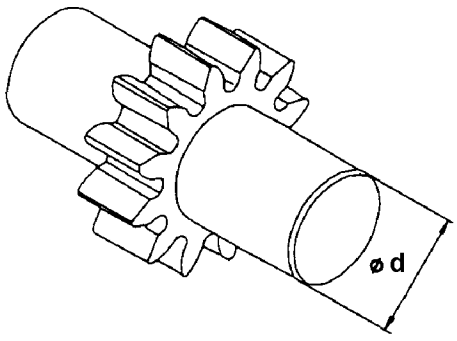


Figure 4. HVZ01982

3. Pressure plate (6)
   The pressure plate is normal if it presents smooth and glossy gear contact surfaces on the side of the sliding surface as shown in Figure 5. The sliding surface of the plate is black coated. Even if it is partially worn and the lower layer is exposed, it is not a problem unless the conditions listed below are found.
   If the following conditions are discovered, replace with new parts:
   - There are many gouges on the plate and the surface is significantly rough
   - The thickness is less than 6.676mm
4. Mounting flange (4) and cover plate
   Check the mounting flange and cover for partial wear of the bearing. See Figure 6.
   - If the Teflon layer is worn and the brown portion of the ground metal is exposed extending over 150° along the circumference of the bearing, replace it with a new one.
5. Always replace plate seal (7), back-up ring (8), oil seal (9) and snap ring (10) whenever they have been disassembled.

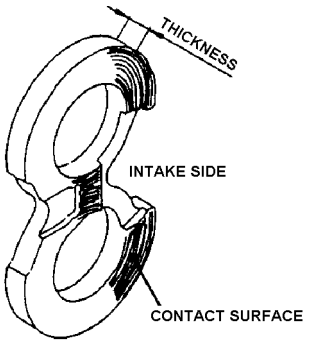


Figure 5. HVZ01983

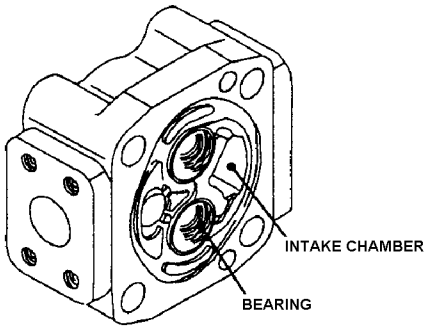


Figure 6. HVZ01984

ASSEMBLY OF FRONT PUMP - DIESEL ENGINE LIFT TRUCK (SEE FIG. 1 AND 11)

1. Clean the parts thoroughly.
2. Insert the casting surface with the mounting surface of the mounting flange down and secured in a padded vise.
3. Firmly fit plate seal (7) and back-up ring (8) in the groove of mounting flange (4) so that they will not protrude from the surface of the outer circumference.
4. Set gear plate assembly (1) to the dowel hole of mounting flange and install it on the mounting flange. At this time, dowel pins press fitted in the gear plate can be used for positioning. If the dowel is too tight to press into the hole, lightly tap it in with a wooden hammer.
5. Insert pressure plate (6) into the bottom of gear plate assembly (1) with the grooved surface up. Pay attention to the locations of the intake and discharge sides of the pressure plate. (See Figure 8.).
   If the pressure plate is tilted and it cannot be removed, hold the driveshaft end of the front drive gear (2) and lightly press against the higher portion to unjam the plate and make the work easier.
6. Insert front drive gear (2) and driven gear (3) by aligning with set marks put on the shaft end during disassembly. At this time, pay close attention to the locations of the drive gear and the driven gear.
   After inserting the gears, pour clean hydraulic oil (approximately 2 or 3 cubic centimeters) in the grooves of the gear teeth.
7. Insert pressure plate (6) with the grooved surface downward in gear plate assembly (1). At this time, pay attention to the location of the intake and discharge sides. (See Figure 8)

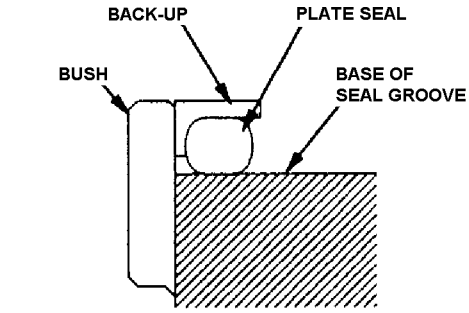


Figure 7. HVZ01985

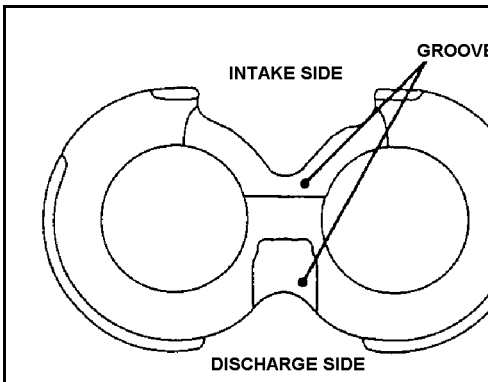


Figure 8. HVZ01986

8. Firmly fit plate seal (7) and backup ring (8) in the groove of mounting flange (4) so that they will not protrude from the surface of the outer circumference.
9. Install cover plate (5) on gear plate assembly (1) by setting it to the dowel pin. At this time, use care that plate seal (7) and back-up ring (8) do not fall off or protrude. If the cover cannot be fully pushed in (leaving 2 - 3mm) the seals fitted in steps 3. and 8. may not be properly in position. Recheck those seals.
10. Insert O-ring (16) and dowel pin (13) in cover plate (5). Use care that the O-ring is not caught or pinched. Then insert spline coupling (12) in the spline of front drive gear (2).
11. Install adapter plate (11) by setting it to the dowel pin on cover plate (5). Use care that the O-ring does not protrude.
12. Insert O-ring (19) in adapter plate (11).
13. Set plain washer (15) in the bolt seat of adapter plate (11) and insert socket head bolt (14) and tighten it to 118 - 127 Nm (87 - 93.7 lbft). Keep the threads wet.
    Caution:
    Make sure to tighten to the specified torque. If the bolt torque is too little or too much, it may cause serious hydraulic oil leakage and may result in an accident.
14. Fit O-ring (22) in connector cover (20) and set it in cover plate (5). Insert socket head bolt (21) and torque to 34 - 39 Nm (25 - 28.8 lbft). Keep the threads wet.
15. Set the spline of rear pump (23) (KP10 assembly) to spline coupling (12) and install it on adapter plate (11). Install the rear pump while paying attention to the orientation of the intake and discharge sides. Set washer (18) and bolt (17) and torque bolt to 42 - 46 Nm (31 - 34 lbft).
16. Remove the pump from the vise and try to turn the shaft end of the drive gear with a suitable tool. It should turn easily by hand. If it does not turn easily by hand pressure, foreign material may have entered the pump during assembly. This will require disassembly and reassembly to correct the problem.
17. Fit oil seal (19) into mounting flange (4). Apply clean lithium grease to the lip of the oil seal. See Figure 9 for oil seal fitting instructions.
    When press fitting the oil seal, use care not to scratch the lip and not to tilt the oil seal. Apply tape over the drive gear shaft end to protect the seal lip. Be sure to remove the tape afterwards.
    The oil seal can be securely press fitted when using the jig shown in Figure 10.

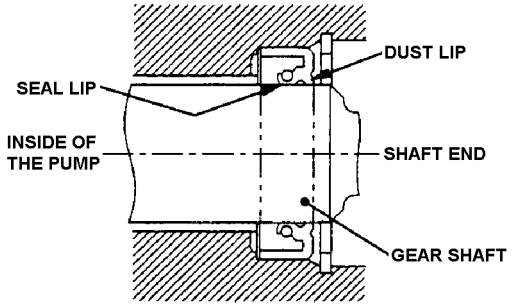


Figure 9. HVZ01987

18. Insert snap ring (10) that holds the oil seal in place. Always use a new snap ring.

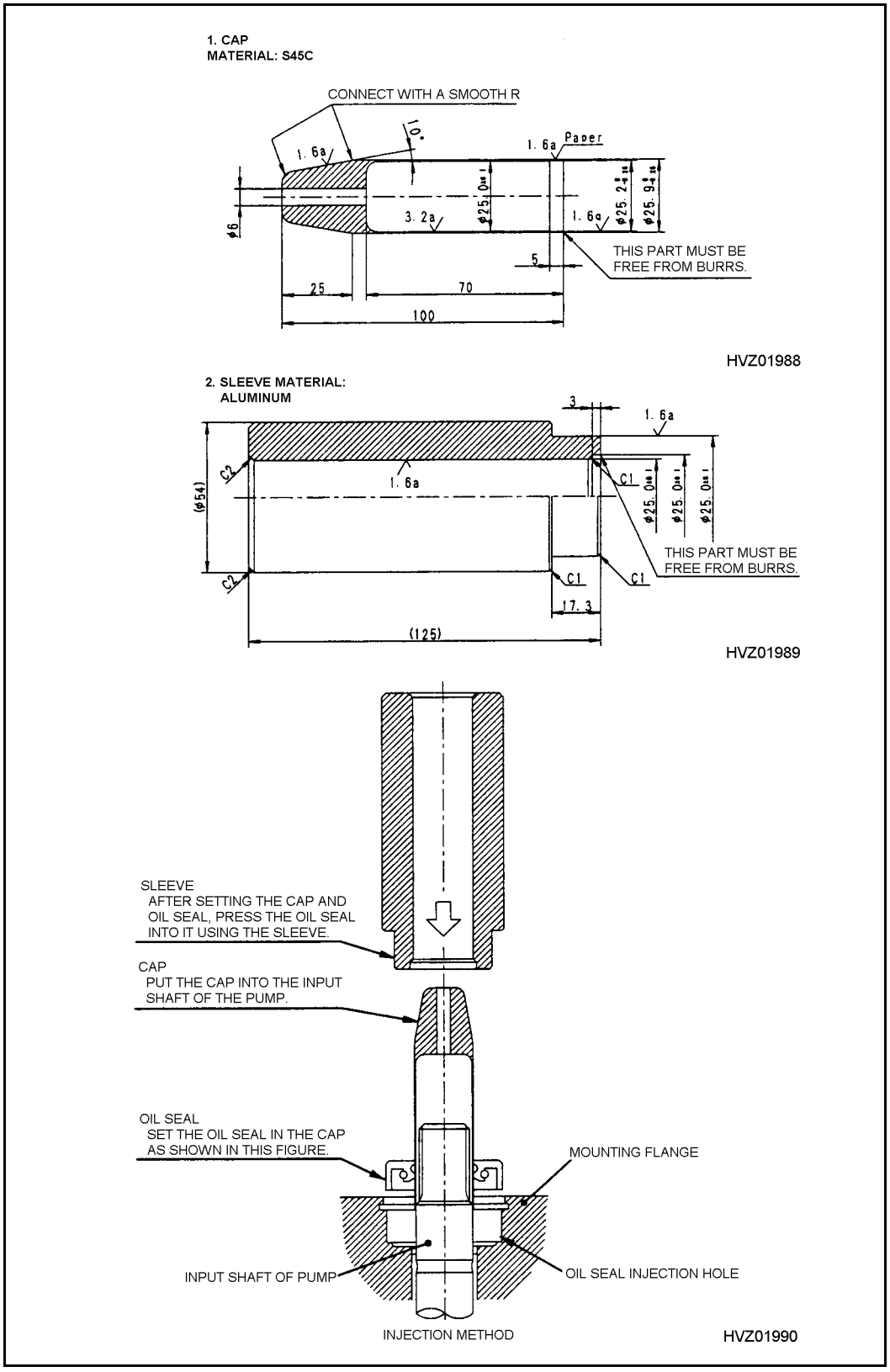
Assembly of the pump is now complete. Before installing the pump on the system, check that assembly procedures and direction of rotation are correct.
Give attention to the following points when installing the pump:

1. Are there any scratches or marks on the centering location boss on which alignment is based?
2. Are there any scratches or contaminant on the mounting surface of mounting flange (4)? Special care must be taken to ensure that the vise is not over-tightened on the flange.
3. Are there any scratches or contaminant on the flange surface of the pipe?
   If there are nicks or contaminants, remove them with a fine oil stone.

Give attention to the following points taken during assembly:

1. When reassembling gear assembly (1), gears (2) and (3) and pressure plate (6), care must be taken that the locations and orientation are exactly the same as before disassembly.
2. Since a cast iron housing is used for KFP32 series, special consideration must be taken to control the amount of clearance at the tooth tip. This will be different from the conventional aluminum alloy pump housing.
   If either mounting flange (4) or cover plate (5) is replaced, make sure to replace drive gear (2) and driven gear (3) with new gears. Otherwise, the specified and required volume of pump discharge may not be obtained.

Figure 10.


1. CAP
MATERIAL: S45C
CONNECT WITH A SMOOTH R
10°
1.6a
1.6a
Paper
3.2a
1.6a
THIS PART MUST BE FREE FROM BURRS.
5
25
70
100
HVZ01988
2. SLEEVE MATERIAL: ALUMINUM
3
1.6a
C2
1.6a
C1
THIS PART MUST BE FREE FROM BURRS.
C2
C1
C1
17.3
(125)
HVZ01989
SLEEVE
AFTER SETTING THE CAP AND OIL SEAL, PRESS THE OIL SEAL INTO IT USING THE SLEEVE.
CAP
PUT THE CAP INTO THE INPUT SHAFT OF THE PUMP.
OIL SEAL
SET THE OIL SEAL IN THE CAP AS SHOWN IN THIS FIGURE.
MOUNTING FLANGE
INPUT SHAFT OF PUMP
OIL SEAL INJECTION HOLE
INJECTION METHOD
HVZ01990

PUMP (REAR) (DIESEL ENGINE LIFT TRUCK)

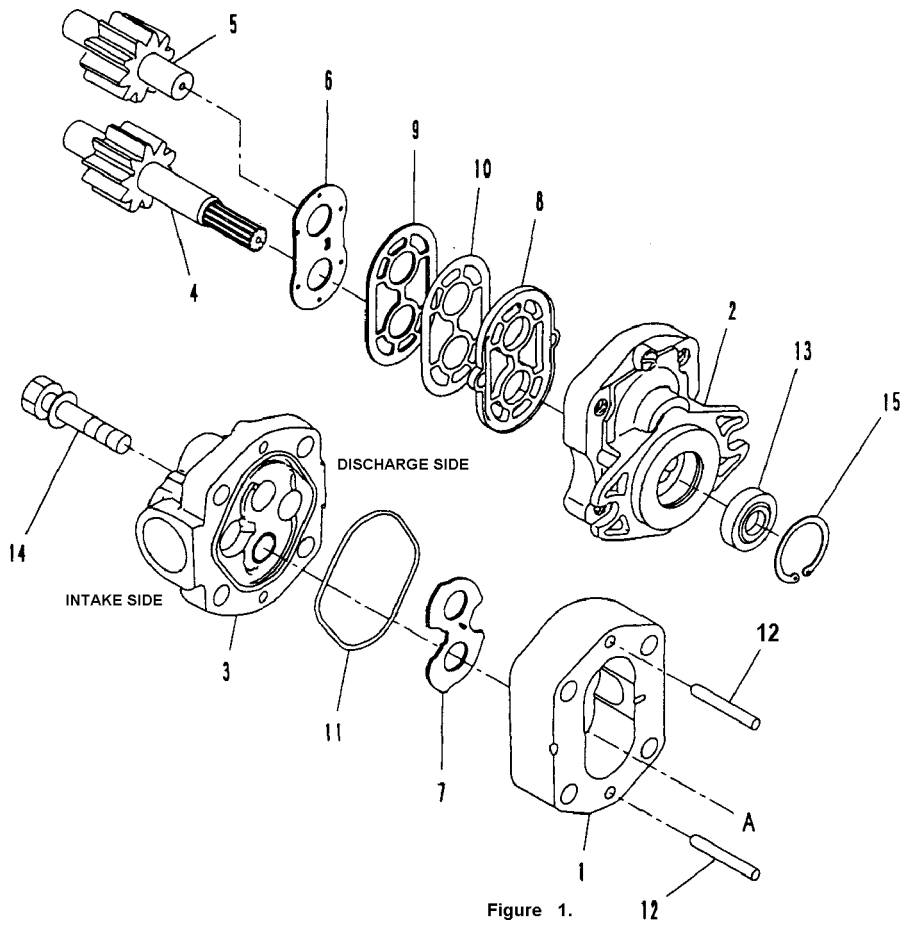


Figure 1.

Item	Description	Qty	Item	Description	Qty
1	Gear plate	1	9	Gasket A	1
2	Mounting flange	1	10	Gasket B	1
3	Cover	1	11	O-ring	1
4	Drive gear	1	12	Dowel pin	2
5	Driven gear	1	13	Oil seal	1
6	Side plate A	1	14	Bolt with washer	4
7	Side plate B	1	15	Snap ring	1
8	Balance seal	1	--	----------	--

DISASSEMBLY - PUMP (REAR) (DIESEL ENGINE LIFT TRUCK) (SEE FIG. 1.)

1. When disassembling, clean the surface of the pump and the driveshaft. Use care not to contaminate, scratch or nick the disassembled parts by placing them on clean paper or cloth. Place the parts in order of disassembly so that they can be reassembled in the proper sequence.
2. Insert mounting flange (2) into a padded vise with the pump mounting surface facing down and secure it. Do not over-tighten the vise.
3. Loosen and remove bolt with washer (14).
   Caution:
   When loosening bolts, gradually apply force to prevent pulling the flange from the vise. Use an appropriate tool (wrench) that is not worn.
4. Remove cover (3) in the axial direction in a straight line. If it is too tight to remove easily, lightly tap it with a wooden hammer in the same direction as removal.
5. Remove O-ring (17) and side plate B (7).
6. Put the set mark on the shaft end face of drive gear (4) and driven gear (5) and pull out the gear. (Mark with an oil stone or marker).
7. Pull side plate (6) out of the bottom of gear plate (1). Use care not to tilt the side plate. If the side plate has been tilted and cannot easily be pulled out, hold and insert the drive shaft end of the drive gear into the gear plate and lightly press against the higher portion of the side plate A. The side plate should fall into its original position. Then pull it out squarely.
8. Remove gear plate (1) from mounting flange (2). Lightly tap around the gear plate with a wooden hammer and pull it upwards to remove.
9. Remove balance seal (8), gasket A (9) and gasket B (10) from the setting surface of mounting flange (2). At this time, insert the tip of a blunted screw driver, or similar tool, into the hole of the balance seal and gently pull them upwards.
10. Remove snap ring (15) from mounting flange (2) and remove oil seal (13). Tap out the oil seal from the inside, using a blunted screw driver or the like. Use care not to damage the oil seal press fitting hole and bearing hole.
11. Disassembly is now complete. Use care when placing the disassembled parts. Keep them in proper disassembled order to ensure proper reassembly sequence.

INSPECTION AND REPAIR PROCEDURES

First check the disassembled parts for contamination or discoloration and then clean them with diesel oil. DO NOT dip rubber parts in diesel oil. Check all parts for the following items. Repair or replace any defective parts.

1. Gear plate (1)
   The gear pump is designed to rotate while the gear teeth tips are in contact with the inner gear hole surface to improve volumetric efficiency. Therefore, if the pump has been driven one or more times, the evidence of the contact of the gear teeth can be seen in the area of the intake port of the pump. (See Figure 1.)
   If the trace of contact is not more than 1/2 of the circumference of the gear pump, it is normal. Approximately 0.05mm is a normal value for the depth of the trace contact "**a**" as shown in Figure 2. If the depth "**a**" exceeds 0.15mm, wear of the shaft or the bearing is assumed to excessive. Carefully check these parts.
   If the depth "**a**" is 0.15mm or greater, replace the entire pump assembly with a new unit.
   See Figure 7. If the diameter of the gear "**d**" is less than 24.895mm, replace with a new gear set.
2. Drive gear (4) and driven gear (5)
   If the hydraulic oil is clean, the relative roughness of the gear and the side of the gear is hardly altered, and they present smooth contact surfaces. If the surface of the gear or the side of the gear displays gouges or scoring or the surfaces of the gear teeth are abnormally or partially worn, replace with new parts.
   See Figure 4. If the diameter of the gear "**d**" is less than 14.96mm, replace with a new gear set.

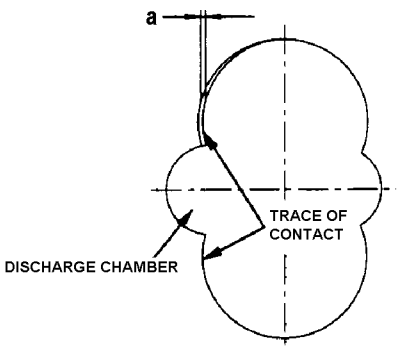


Figure 2. HVZ01992

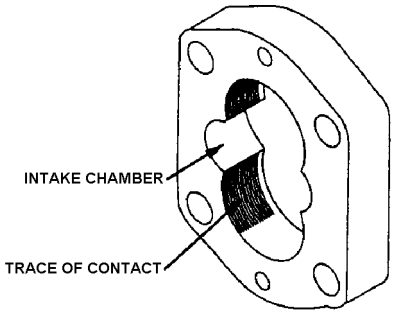


Figure 3. HVZ01993

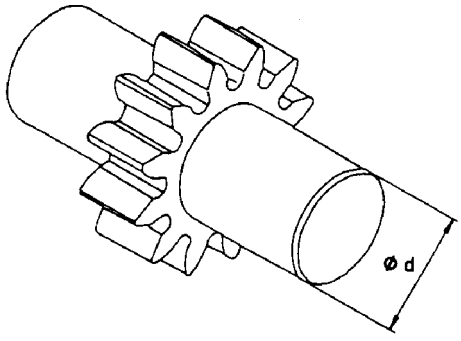


Figure 4. HVZ01994

3. Side plate A (6) and side plate B (7)
   The side plate is normal if it presents glossy gear contact surfaces on the side of the sliding surfaces as shown in Figure 5.
   - If, during disassembly, gouges and scoring are found on the plate surface or the surface is noticeably rough, replace it with a new part.
4. Mounting flange (2) and cover(3)
   Check the mounting flange and the cover for partial wear of the bearing (See Figure 6).
   - If the Teflon layer is worn and the brown portion of the ground metal is exposed extending over 150° along the circumference of the bearing, replace it with a new one.
5. Always replace O-ring (11), balance seal (8), gaskets A (9) and B (10), oil seal (13) and snap ring (15) with new parts on every disassembly and reassembly operation.

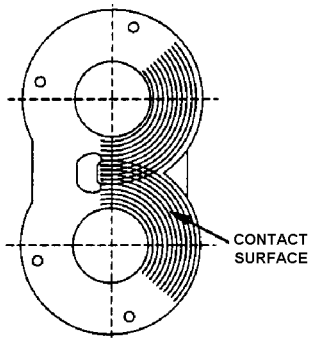


Figure 5. HVZ01995

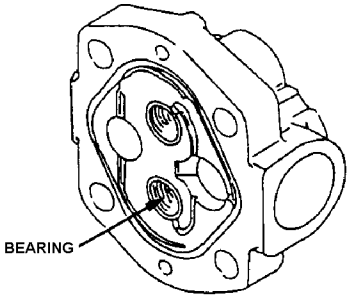


Figure 6. HVZ01996

ASSEMBLY (SEE FIGURES 1., 7. - 10.)

1. Clean all parts thoroughly.
2. Insert the casting surface in a padded vise with the mounting surface of mounting flange (2) downwards.
3. Fit balance seal (8) into the groove of mounting flange (2) by pressing with finger.
4. Fit gasket B (10) and gasket A (9) in order into balance seal (8). Now press gasket A into the groove so that it is even with the mounting flange surface.
5. Insert dowel pin (12) in gear plate (1) and place it on mounting flange (2). Position it with two dowel pins. Use care to ensure that gear plate is properly oriented (i.e intake, discharge, front, rear). The gear plate setting surface, with the notched groove, must be placed down (on the mounting flange side). See Figure 7.
6. Insert side plate A (6) into the back of gear plate (1) with the copper alloy surface up. Pay particular attention to the orientation of the intake and discharge sides. See Figure 8.
   If the side plate is tilted and cannot be moved, hold the driveshaft end of drive hear (4) and lightly press inward on the higher portion to make the work easier.

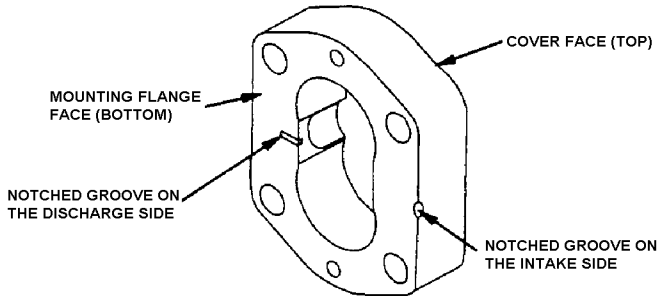


Figure 7.

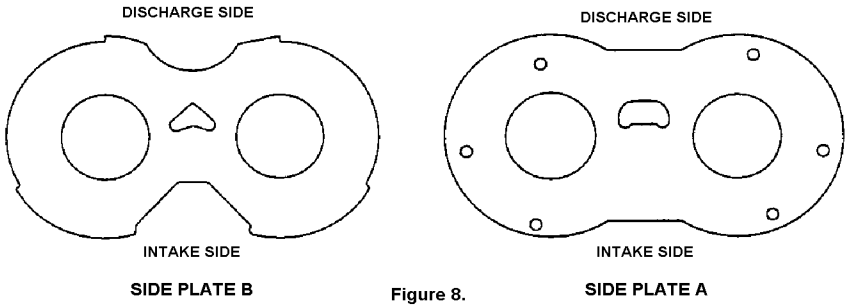


Figure 8.

7. Insert drive gear (4) and driven gear (5) by aligning with set marks put on the shaft end during disassembly. Pay close attention to the locations of the drive gear and driven gear.
   After inserting the gears, pour about 2 - 3 cubic centimeters of clean hydraulic oil into the grooves of the gear teeth.
8. Insert side plate B (7) in gear plate (1) with the copper alloy surface down. Pay close attention to the orientation of the intake and discharge sides (See Figure 8).
9. Fit O-ring (11) into the groove of cover (3) and place the cover on gear plate (1). Note that the letters “IN” are located on the intake side.
10. If the gap between the cover and gear plate (1) exceeds 1.3mm when cover (3) is lightly pressed, the O-ring is off the groove and must be reinstalled properly.
11. Insert bolt with washer (14) into the bolt hole and tighten it with a torque of 34 - 39 Nm (25 - 28.8 lbft) Keep the threads wet.
    Caution:
    Be sure to tighten to specified torque. If the bolt is improperly torqued, a serious leak may occur resulting in an accident.
12. Remove the pump from the vise and fit oil seal (13) and snap ring (15) into the mounting flange. Apply a light coat of clean lithium grease to the lip of the oil seal. For fitting instructions, see Figure 9.
    When press fitting the oil seal, use care not to scratch the lip and not to tilt the oil seal. Applying tape over the drive gear shaft end will help to prevent scratches and damage to the seal. Remove the tape after seal installation.
    The oil seal can be securely press fitted by using the jig shown in Figure 10.
13. Turn the shaft end of the drive gear with a tool. If it can be turned easily by hand, the drive gears are clean and seals are properly in place. If it is excessively tight, there may be an assembly problem and the pump will require disassembly and reassembly.

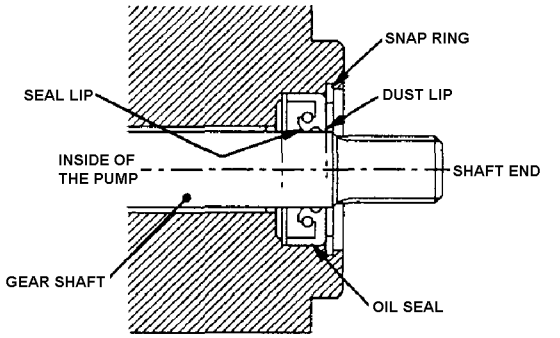


Figure 9. HVZ01999

Assembly of the pump is now complete. Again check to be sure that assembly procedures performed and rotation direction are correct.
When installing the pump, pay close attention to the following items:

1. Are there any scratches on the centering location boss on which alignment is based?
2. Does the mounting flange (2) display any scratches or any contaminant on the mounting surface?
   Care must be taken not to over-tighten the vise on the flange.
3. Are there any scratches or contaminants on the flange surface of the pipe?
   Use a fine oil stone to remove any nicks or contaminants.

Pay special attention to the following during reassembly:

1. When reassembling gear plate (1), gears (4) and (5), side plate A (6) and side plate B (7), use care to ensure that part locations and orientation are exactly the same as they were prior to disassembly.

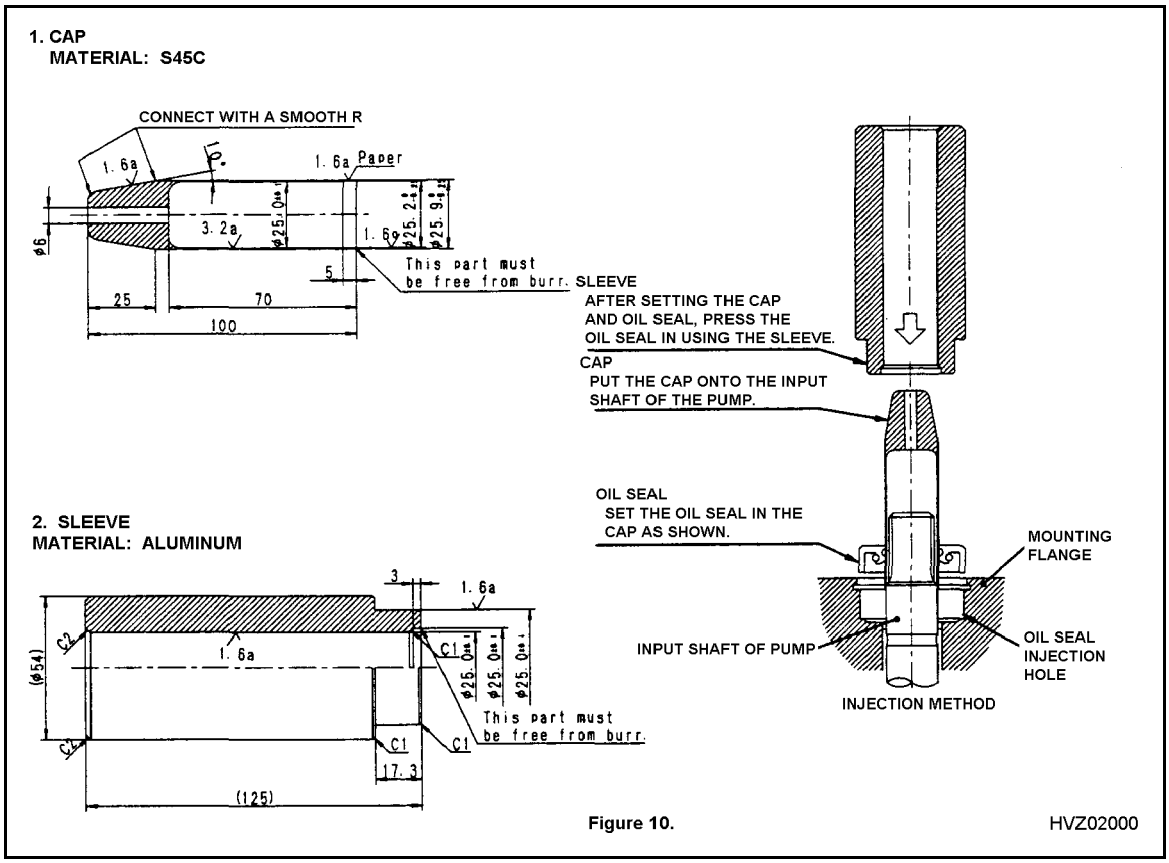


Figure 10. HVZ02000

TESTING THE PUMP

Testing is performed in order to ensure that the pump is assembled correctly and that it will perform as designed, without leakage.

Testing will be performed on the lift truck, and should be done in the order shown below. If the pump is burned or seized, or the inside of the pump is abnormally worn, change the hydraulic oil and filter before testing.

1. Install the pressure gauge in the line on the high pressure side in the area of the pump discharge port.
   Carry out the test while checking the pressure gauge.
2. Operate the pump by setting the revolutions to between 500 - 1,000 rpm with the control valve in the neutral position. As the valve is placed in the neutral position, the reading on the pressure gauge must be below 1 MPa (10kgf/cm^2) (145 psi). Keep the pump running for 10 minutes.
3. Then, increase the revolutions to 1,500 - 2,000 rpm and run the pump without load for 10 minutes in the same manner as Step 2.
4. Run the pump by increasing the pressure by 2 - 3 MPa (20 - 30 kgfm/cm^2) (290 - 435 psi) for every five minutes up to the maximum pressure at 1,500 - 2,000 rpm. Do this by either adjusting with a relief valve or applying an appropriate load. After operating each circuit for five minutes, replace the return filter element with a new one or clean the filter.
   Caution:
   If the oil temperature or the surface temperature of the pump rises abnormally, or the pump is making noise, stop the test and shut down the lift truck. Identify the problem and repair as necessary.
5. Upon completion of the above procedures, reset the relief valve.
   Caution:
   Set the pressure of the relief valve precisely. If the pressure is set too high, it may break the pump housing causing hydraulic oil to spray out and possibly causing an accident. Otherwise it may significantly reduce the durability of the pump.
6. Test pump discharge volume with load applied, and without load, and verify that the work equipment speed and operation is normal.

TROUBLESHOOTING
(WHEN PUMP IS AT FAULT)

Problem	Cause	Remedy
No oil is discharged from the gear pump	Low oil level in the tank	Add hydraulic oil to the specified level
	Pipe on suction side or strainer is obstructed	Immediately clean and remove obstruction. If oil is contaminated, replace oil and filter.
Gear pump pressure does not increase	• Excessive wear to side plates A (6) and B (7) • Excessive wear to bearing (press fitted into (2) and (3)) • Defective balance seal (8) and gaskets A (9) and B (10)	Replace with new parts
	Improperly adjusted relief valve	Adjust relief valve using pressure gauge. Set to specification.
	Air in system	• Fix loose pipe on suction side • Refill tank with hydraulic oil • Check pump oil seals • Do not operate lift truck until air bubbles in tank disappear
Gear pump generates abnormal noise	Cavitation caused by flattened hose on suction side or clogged strainer	Remove obstructions and/or clean strainer
	Air drawn into system at loose joints/fittings on suction side	Tighten all joints and fittings
	Cavitation caused by excessive oil viscosity	• Install oil of correct viscosity • Run at correct oil temperature
	Failed centering location of shaft from pump and engine	Relocate centering
	Air bubbles in hydraulic oil	Identify and correct cause for formation of air bubbles
Oil leaks from the pump	• Defective pump seal (13) in the pump • Defective O-ring (11) • Defective balance seal (8)	Replace with new parts
	Contaminated seal(s)	Recheck the pump

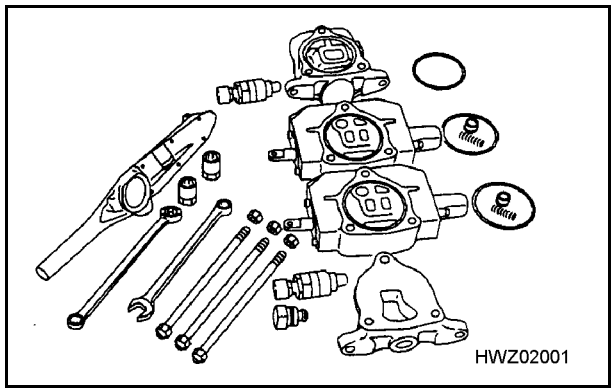
CONTROL VALVE

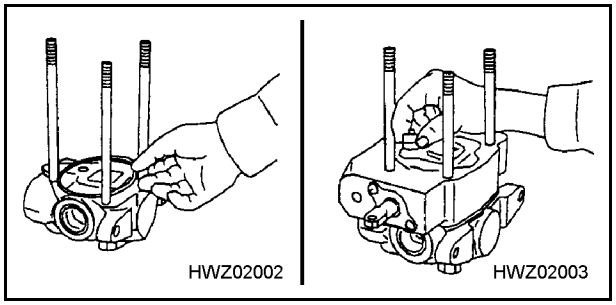
ASSEMBLY PROCEDURES

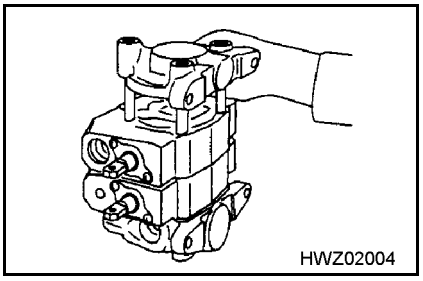
1. Lay out valve components on a clean, flat working surface. The inlet assembly will include an O-ring, and the spool section(s) include an O-ring, a load check poppet and a load check spring. Tools required for basic valve assembly include 3/4” and 11/16” open or box end wrenches, and a torque wrench with thin-wall sockets.
2. Assemble tie rod nuts to one end of each tie rod with one or two threads left showing. Insert tie rods through tie rod holes of inlet (larger tie rod at the top). Lay inlet on end with tie rods pointing up and place O-ring into position.
3. Place first spool section (O-ring side up) on inlet section, position O-ring and insert load check poppet (nose down) and spring (behind poppet) into load check cavity as shown. Repeat this procedure for each spool section. The load check springs are compressed by the following sections during assembly.
4. Position end section on last spool section as shown and hand tighten tie rod nuts. The end section, in Figure at right, is a “turn around” section without port. Universal outlet / power beyond section and power beyond and closed center sections are also used as end sections. These end sections do not have O-ring grooves.
5. Position valve assembly with the mounting pads of the end sections on a flat surface. To obtain proper alignment of end sections relative to the spool sections, apply downward pressure to the end sections. Snug tie rod nuts to about 10 lbft.
   Final torque the two 11/16” nuts to 48 $\pm$ 5 lbft. Final torque the 3/4” nut to 74 $\pm$ 8 lbft. Check for proper spool movement.
6. Install auxiliary valves and plugs, and torque to proper specifications.

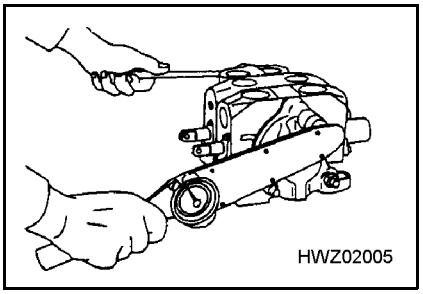
General assembly notes:

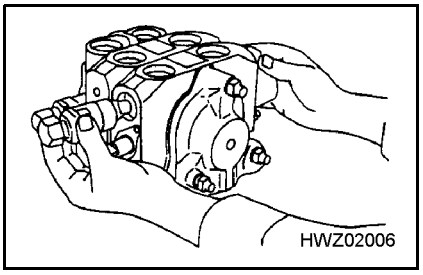
1. Lever assemblies can be installed on section before or after complete valve assembly.
2. The load check and spring may be omitted from assembly in certain circuit conditions (i.e. motor spools).











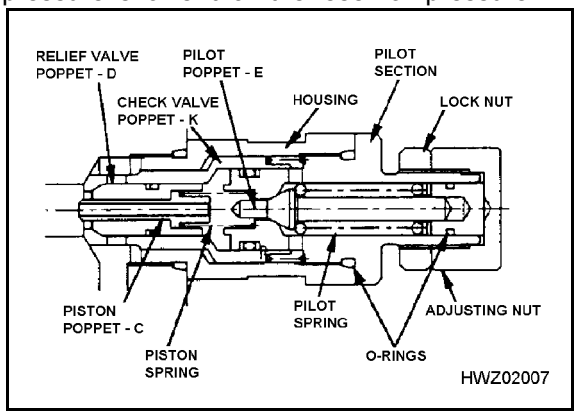
SETTING PRESSURE ON WORK PORT RELIEF

There are several variations of the Work Port Relief, however, all are similar in nature regarding service and repair.

A good pressure gauge must be installed in the work port relief line. Apply a load in such a way as to reach the port relief set pressure. Then follow the following steps:

- Loosen lock nut
- Set adjusting nut to desired pressure setting
- Add or remove shims as needed to achieve desired pressure setting
- Tighten lock nut
- Retest using same steps as above

The Void Control Feature is not adjustable, but it is designed to operate whenever the work port pressure is lower than the reservoir pressure.



SERVICE AND REPAIR

The cartridge type work port reliefs used in these valves are typically of the pilot poppet type with external adjustment. Any malfunctioning is usually the result of foreign matter lodging between the piston, relief valve poppet and check valve.

To perform service, clean the surrounding area and remove the complete relief valve cartridge. Examine the seat in the main valve housing and if grooves or ridges are present, replace the control valve with a new unit.

The design of the pilot poppet and its seat provides positive seating and rarely requires any maintenance.

The pilot section can be removed from the cartridge housing without disturbing the setting. The check valve poppet and other parts will come with it, and they should be checked for any foreign matter. Seats and seating surfaces should be smooth and free of nicks, scratches or grooves. Replace O-rings and back-up washers if damaged. Moving parts should slide freely.

After inspecting and cleaning, dip all parts in hydraulic oil and reassemble.

If the unit still does not function properly, contact your dealer/distributor for a replacement part.

Problem	Probable cause	Remedy
• No pressure	• Poppet D, E or K stuck open • Contamination under seat	Check for foreign matter in the poppets and their mating parts. Parts must slide freely without sticking.
• Erratic pressure	• Pilot poppet seat damaged • Poppet C sticking in D	Replace the relief valve. Clean and remove surface marks for free movement.
• Incorrect pressure setting	• Normal wear. Lock nut and adjustment screw loose.	See “Setting Pressure on Work Port Relief” above.
• Leakage	• Damaged seats. Worn O-rings. • Parts sticking (contamination).	Replace the relief valve. Install seal and spring kit. Disassemble and clean.

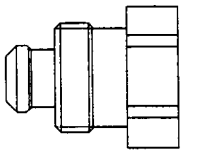
TROUBLESHOOTING ANTI-VOID

Malfunctions can usually be traced to foreign matter plugging the sensing hole or preventing the free movement of the poppet.

Also check seat for scratches, nicks or other marks.

SHUT-OFF VALVE

Shut-off valves are available to fit most work port and main relief valve machining locations.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SERVICE INFORMATION

COMBINATION WORK PORT RELIEF AND ANTI-VOID UNIT

As work port relief

STEP 1. The relief valve is in communication between the high pressure port “HP” and low pressure “LP”. Oil is admitted through the hole in poppet C and, because of the differential area between diameters A and B, relief valve poppet D and check valve poppet K are tightly seated.

STEP 2. The oil pressure in the high pressure port “HP” has reached the setting of the pilot poppet spring force and unseats the pilot poppet E. Oil now flows around the poppet, through the cross-drilled holes and to the low pressure area “LP”.

STEP 3. The loss of oil behind poppet C, effected by the opening of pilot poppet E, causes poppet C to move back and seat against pilot poppet E. This shuts off the oil flow to the area behind relief valve poppet D, and causes a low pressure area internally.

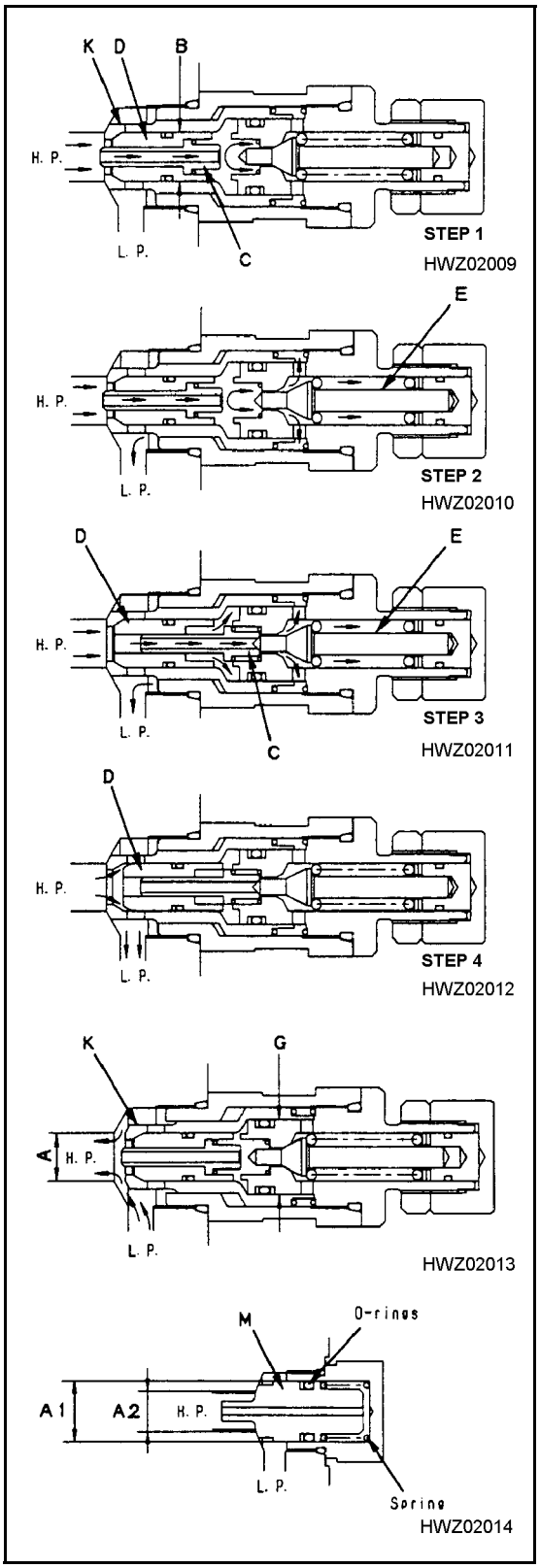
STEP 4. The imbalance of pressure on the inside as compared to that of the high pressure port “HP”, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber “LP” in the valve.

As anti-void

The anti-void unit supplies oil to the high pressure port “HP” when cavitation has occurred. A lower pressure exists in the port “HP” compared to the low pressure chamber “LP”. The difference between the effective area of diameter A and G causes imbalance of the check valve poppet K, which unseats, allowing oil from the low pressure chamber “LP” to enter the port “HP” and fill the void. (See Figure to right).

As separate anti-void

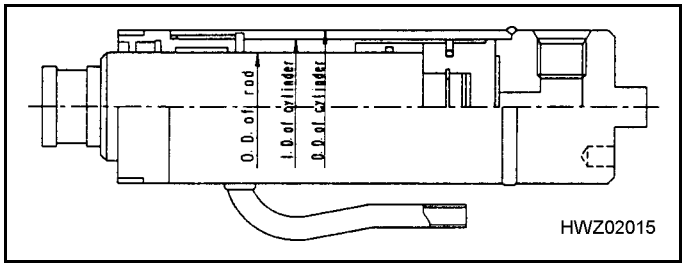
The anti-void check valve opens when cavitation occurs in the high pressure port “HP” and supplies oil from the reservoir “LP” to help fill this void. The poppet M is held on its seat by the port pressure “HP” acting on the larger area behind the O-ring.When pressure “HP” drops below atmosphere, the tank pressure “LP” operating on the annular area A1-A2 will overcome the port pressure “HP” and the spring force to open the poppet. When the void is eliminated, the spring will return the poppet which will then be tightly seated by the port pressure “HP”.



LIFT CYLINDER

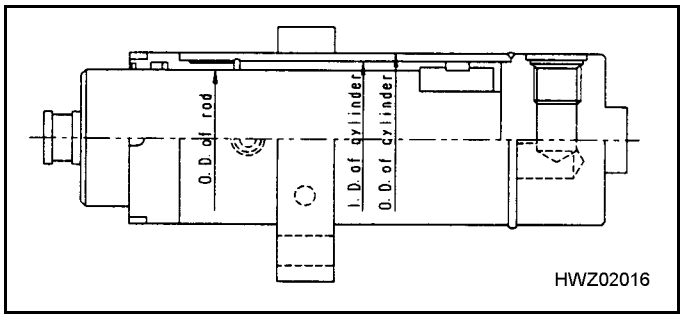
2-Stage Mast (Lifting height: 3.3m (10.83 ft))

Item	Unit	3.5t, 4t	4.5t
Cylinder (I.D. x O.D)	mm (in.)	63.5 x 73 (2 1/2 x 2 7/8)	68.9 x 79.4 (2 3/4 x 3 1/8)
Stroke	mm (in.)	50.9 (2)	54.1 (2.13)
Rod (O.D.)	mm (in.)	50.8 (2)	
Weight (each)	kg (lbs)	45 (100)	47 (104)



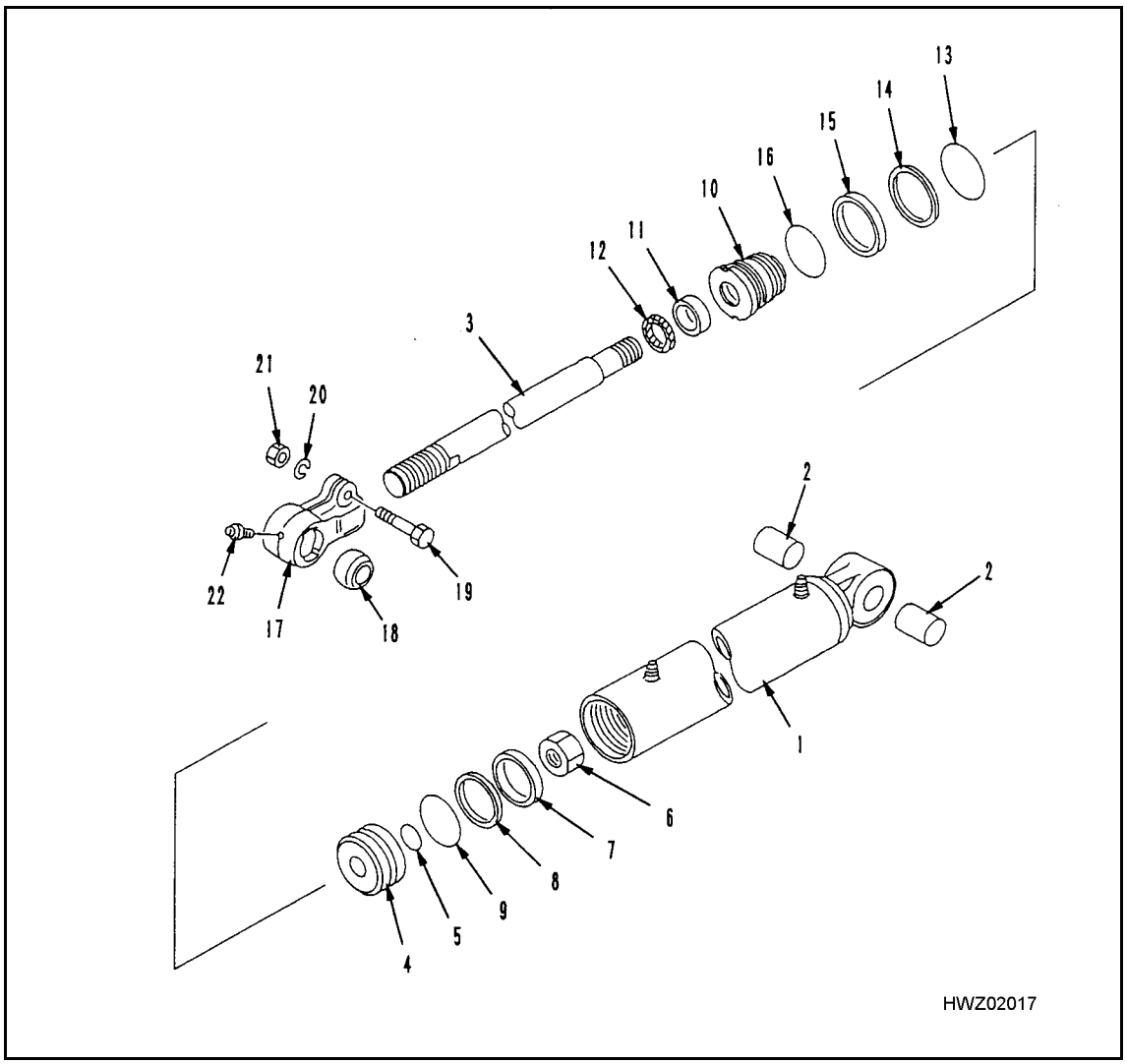
3-Stage Mast (Lifting height: 4.7m (15.42 ft))

		Main Lift		Free Lift	
Item	Unit	3.5t, 4t	4.5t	3.5t, 4t	4.5t
Cylinder (I.D. x O.D.)	mm (in.)	63.5 x 73 (2 1/2 x 2 7/8)	69.9 x 79.4 (2 3/4 x 3 1/8)	114.3 x 127 (4 1/2 x 5)	--
Stroke	mm (in.)	1,517.7 (59 3/4)		857.3 (33 3/4)	
Rod (O.D.)	mm (in.)	50.8 (2)			101.6 (4)
Weight (each)	kg (lbs)	44 (97)	46 (102)	100 (221)	--



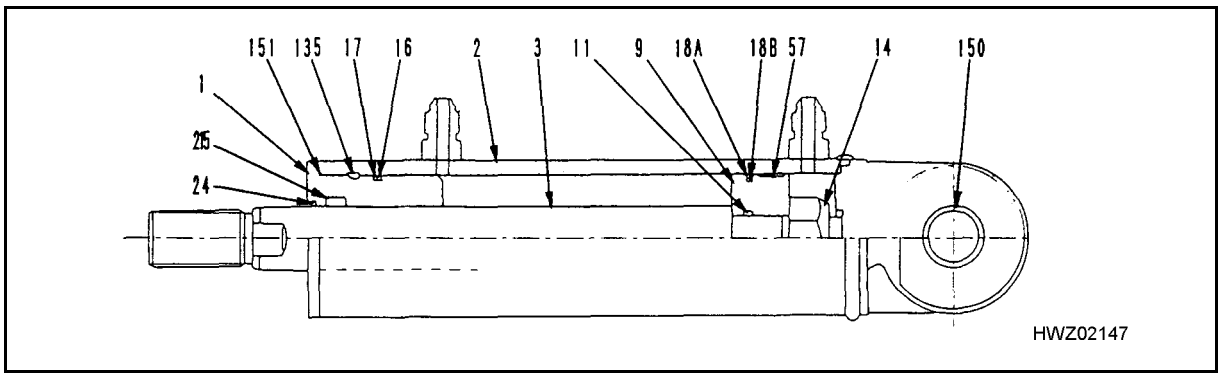
Check item	Detail of check	Remedy
Piston rod cylinder	Gouges, nicks and dents	Replace
Wear ring piston seal	Gouges	

TILT CYLINDER



1. Cylinder tube
2. Bushing
3. Piston rod
4. Piston
5. Seal
6. Lock nut
7. Strip
8. Seal
9. Seal
10. Head
11. Seal
12. Wiper
13. Seal
14. Back-up seal
15. Ring
16. Seal
17. Rod head
18. Bushing
19. Bolt
20. Spring washer
21. Nut
22. Grease fitting

Cylinder (O.D. x I.D.)	4 x 3-1/2		
Stroke	Pneu.	6/12	7-7/32
		6/6	4-51/64
	Cushion		4-59/64
Rod (O.D.)	1-3/4		



ITEM #	DESCRIPTION	QTY	ITEM #	DESCRIPTION	QTY
1	Head	1	18A*	Piston seal	1
2	Tube assembly	1	18B*	Piston seal expander	1
3	Piston rod	1	24*	Rod wiper	1
9	Piston	1	25*	Rod seal	1
11	Piston LD. seal	1	57*	Piston bearing strip	1
14	Piston lock nut	1	135	Shear ring	1
16*	Tube seal	1	150	Pivot bushing	1
17*	Tube seal back-up	1	151*	Water seal	1

* Indicates recommended spare parts

STANDARD SIZE AND REPAIR LIMIT SIZE

The Okuno cylinder does not use repair limit sizes as maintenance criteria for hydraulic cylinders. The following table displays various visual inspections which should reveal potential repair or replacement problems before dimensional changes in components become excessive.

INSPECTION	CHECK ITEM / ITEMS	REMEDY
Visible external leakage	Rod seal, rod wiper, tube seal	Replace components
Abnormal wear marks, dents, scratches on piston rod	Piston rod, rod bearing (front head)	Replace components
Excessive clearance between pivot pin and pivot hole	Pivot pin, pivot bushing, tube assembly	Replace components
Visible jerky or biting movement, squealing or chattering noise	Tube, piston seal, bearing strip	Replace components

MAINTENANCE, DISASSEMBLY AND ASSEMBLY

GENERAL

All parts removed from the cylinder that are to be reused should be thoroughly cleaned. Be sure to clean all cavities and grooves prior to replacing parts.

All parts, new and old, should be lightly lubricated with a clean lubricant of the same type as, or compatible with, the fluid being used in the cylinder.

It is highly recommended that when the cylinder is disassembled for any type of maintenance that all seals be replaced before assembly.

DISASSEMBLY

Cylinder disassembly is easily accomplished using a spanner wrench. Simply rotate the head counter-clockwise until the beveled end of the shear ring starts out of the tube slot. It may be necessary to insert a screwdriver under the bevel of the shear ring to start it out of the slot. Continue to rotate the head until the shear ring is completely removed from the keyway. The head can now be disassembled. Caution should be used to protect the chrome finish on the piston rod when removing the head from the piston rod.

ROD SEAL AND ROD WIPER REPLACEMENT

Use a small blunted screwdriver to remove the rod seal (Item # 25), being careful not to nick or scratch the sides or the top of the seal cavity. In the same manner, remove the rod wiper (Item # 24). When replacing the rod seal, apply a light coating of clean lubricant to the new seal and insert it into the seal groove firmly with the fingers. When replacing the rod wiper, be sure it is fully seated into the groove.

In cases where rod end mounts or connections are welded to the piston rod, it will be necessary to remove the piston (Item # 9) from the piston rod in order to replace the rod seal and wiper. Clamp the piston rod in a soft-jawed vise using caution not to damage the piston rod. Remove the piston lock nut (Item # 14) and slide the piston off the piston rod turndown. The head can now be removed from the piston rod for rod seal and wiper replacement.

When replacing the piston onto the piston rod, it is advisable to replace the LD. seal (Item # 11). Lubricate the piston LD. and LD. seal and reassemble the piston onto the piston rod with the slipper seal groove towards the rod shoulder. Tighten the lock nut securely against the back face of the piston using the torque value provided.

TUBE SEAL, PISTON SEAL AND BEARING STRIP REPLACEMENT

Examine the tube seal and tube seal back-up (Items # 16 and #17) for nicks or cuts and replace if necessary. The new seal should be lubricated before being installed into the groove.

To replace the Teflon piston seal (Item # 18A), cut the seal and remove from the groove, being careful not to nick or scratch the sides of the groove. Remove the expander (Item # 18B) using a blunt screwdriver, again using care not to damage the bottom or sides of the groove. For ease of installation, and to minimize the time that the piston seal is in the stretched condition, the expander and the seal should be installed into the groove from the rod side of the piston. The leading edge of the piston must be free of any deep nicks or burrs before installing the piston seal. Lubricate this edge prior to putting the piston seal into the groove. Lubricate the expander and stretch it over the edge of the piston into the groove. Lift a segment of the piston seal over the lip of the piston and install as much of the seal as possible into the groove by pushing down on the outside of the ring to seat the I.D. on the expander. Place a small blunt screwdriver under the I.D. of the seal that is outside the groove. Pulling outward and inward towards the piston, stretch the seal up and over the lip to align it with the groove. Remove the screwdriver and the seal will snap into the groove. The stretching of the seal into the groove must be done rapidly due to the memory characteristics of Teflon. The longer the seal remains in the stretched condition, the longer it takes the seal to return to its original shape and size.

The piston bearing strip (Item # 57) is a single piece that has scarf cut ends and is simply wrapped around the piston. It is not intended that the cut ends meet to make a seal.

CYLINDER ASSEMBLY

With the above aspects of the cylinder assembly properly completed, lubricate the O.D. of the piston (including the seal and the bearing strip) and install the piston and rod assembly into the tube. The piston and rod assembly should enter straight into the tube, however, sometimes it is helpful to rock the component up and down or sideways in order to move the piston into the tube. It may also be necessary to apply pressure to the bearing strip at the leading edge in order to get it started into the tube. To do this use a small blunted screwdriver and push inward on the bearing strip (toward the center of the piston) at the point where it is entering the tube, while at the same time pushing the piston and rod assembly into the tube. This procedure will also be helpful when the piston seal starts to enter the tube, especially if the seal was stretched more than need be and has not yet returned to its proper size.

Lubricate the O.D. of the head and assemble the head onto the piston rod and into the tube so that the starter hole in the head can be seen through the slot.

Coat the shear ring with a suitable lubricant, such as CMD Extreme Pressure Oil or Alemite Petroleum Lubricant. The lubricant aids greatly in the assembly procedure and the good adhesion qualities help to prevent corrosion build-up in the joint area.

Facing the rod end of the cylinder, with the tube slot in the “up” position and with the beveled end of the shear ring to the left and down, insert the hooked end of the shear ring through the tube slot and into the starter hole in the head. The tube slot position and the shear ring direction in relation to facing the rod end of the cylinder must be maintained regardless of which attitude (vertical or horizontal) the cylinder is being assembled.

Using a spanner wrench, rotate the head clockwise, thus drawing the shear ring into the keyway formed by the tube and the head. Caution should be used so as not to damage the chrome plated piston rod.

Continue to rotate the head clockwise until almost one revolution has been completed (about 335°). The spanner holes in the front head have been located in relation to the starter hole so that when the centerline of the spanner wrench handle is in line with the centerline of the tube slot, the shear ring is in proper position. The ring position can be checked visually by looking into the slot and observing that the ends of the ring are approximately 1/4” inside the edges of the slot.

HAND TOOLS REQUIRED FOR DISASSEMBLY / ASSEMBLY

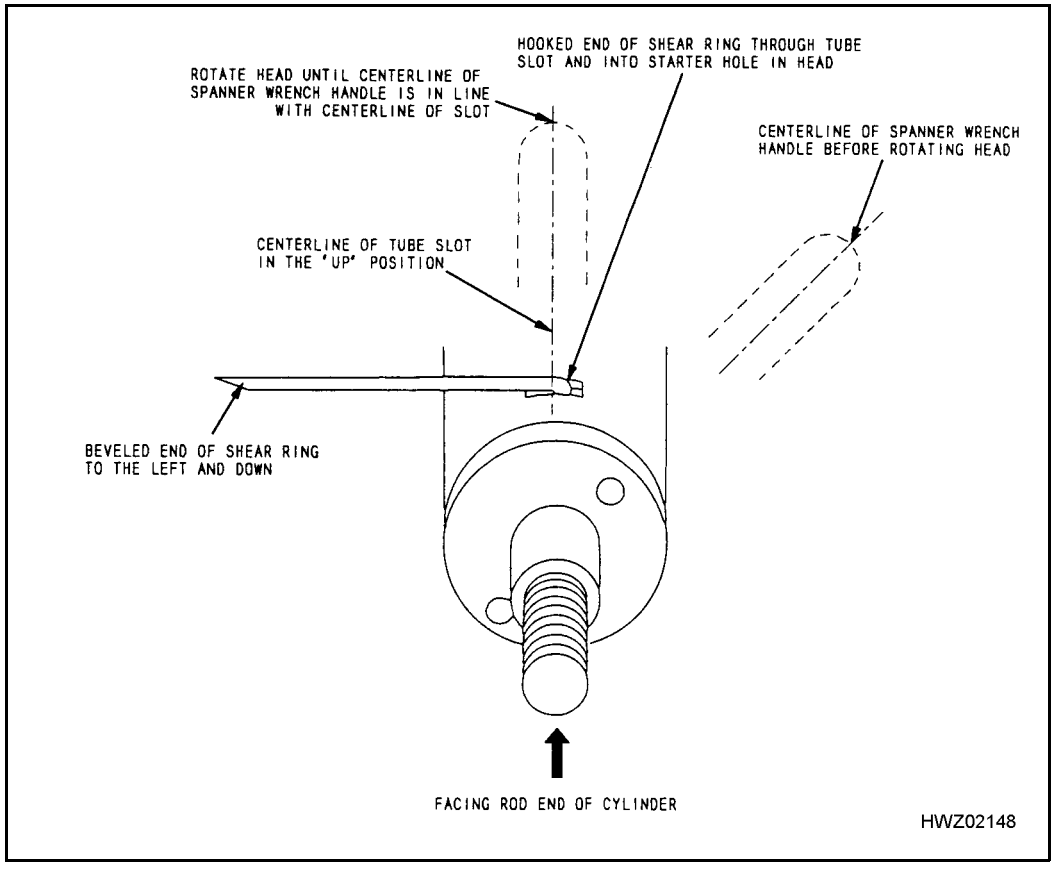
1. Spanner wrench for rotating front head
2. Conventional screwdriver
3. Seal installation / removal tool

NOTE: A small screwdriver, with the sharp edges of the tongue ground blunt, will work well for installing and removing seals.

TORQUE VALUE FOR PISTON LOCK NUTS

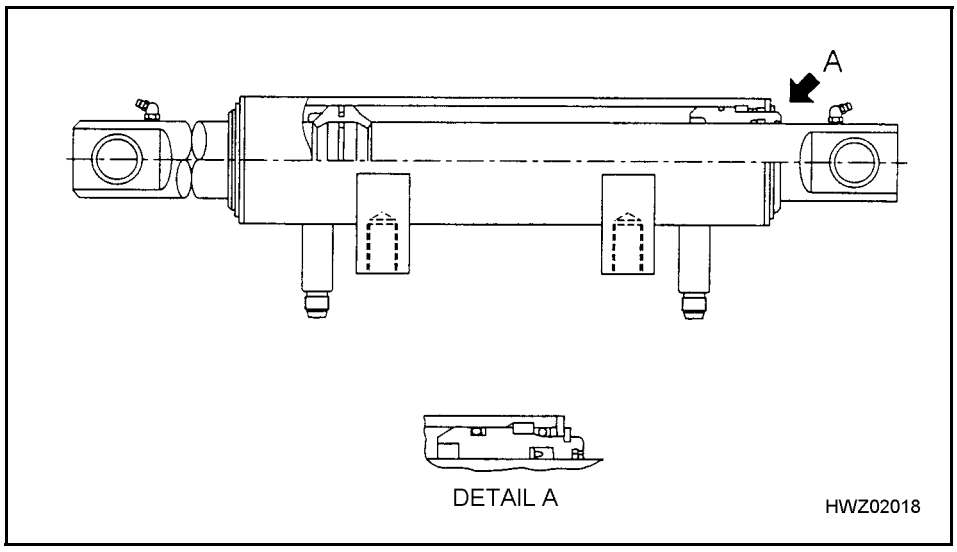
Bore size	Torque (lbft)
3-1/2	290

TILT CYLINDER ASSEMBLY ORIENTATION



POWER STEERING CYLINDER

STRUCTURE



Cylinder (O.D. x I.D.)	3-1/2 x 3 in.
Stroke	8-1/2 in.
Rod (O.D.)	2 in.

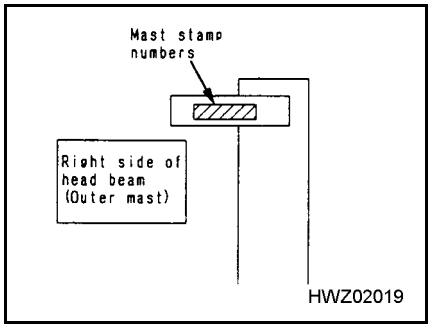
CHECK AND INSPECTION

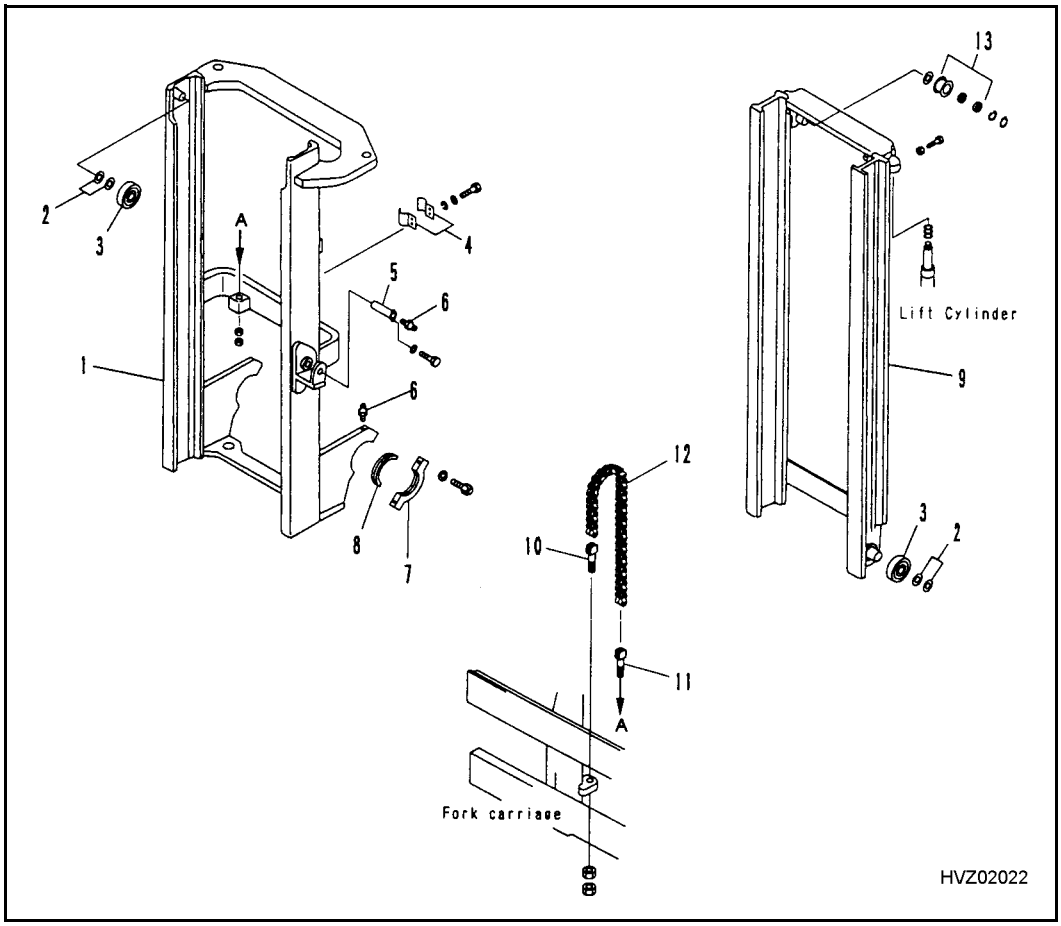
Check item	Detail of check	Remedy
Piston rod cylinder	Gouges, nicks, dents	Replace
Packing seal	Scratches, deformation of lip	

MAST

INTRODUCTION

In any communication concerning your Kalmar lift truck mast, refer to the mast number stamped on the nameplate. If the nameplate is missing, these numbers are also stamped on the right side of the head beam. See Figure below.

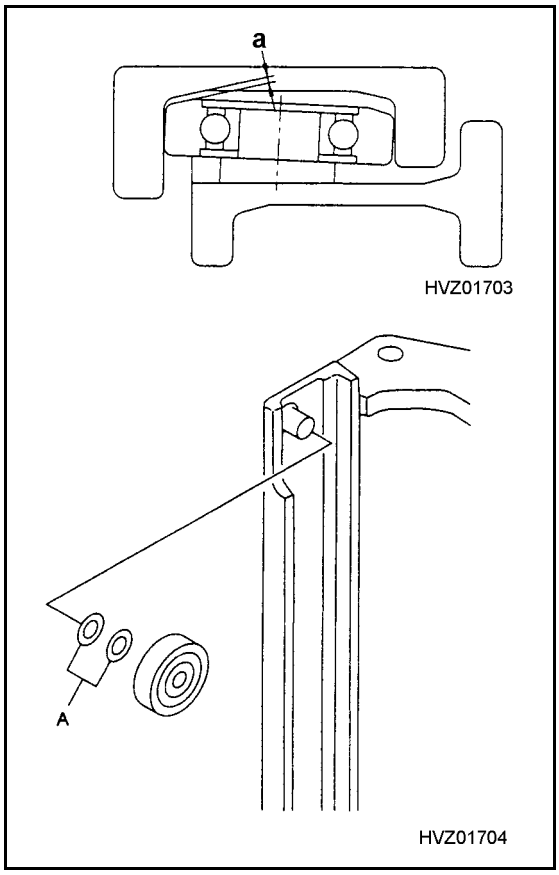




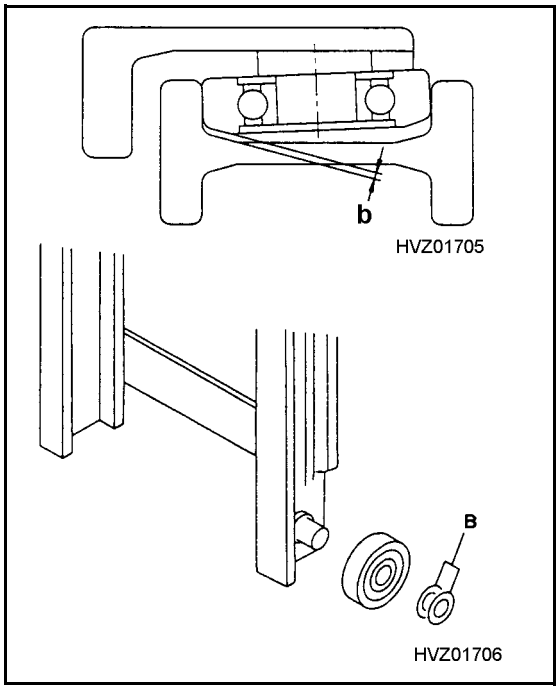
1. Outer mast
2. Shim
3. Roller
4. Lift cylinder clamp
5. Tilt cylinder pin
6. Grease fitting
7. Mast cap
8. Bushing
9. Inner mast
10. Chain stopper
11. Chain stopper
12. Lift chain
13. Chain wheel

ADJUSTMENT

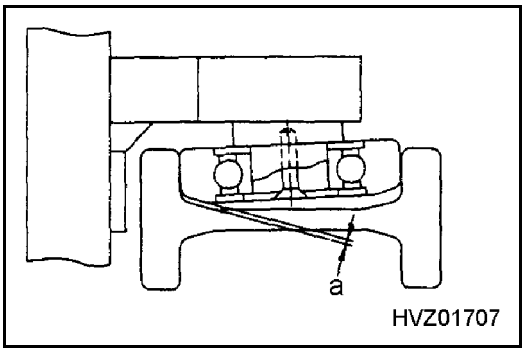
1. Outer main roller
   Adjusting shims
   Adjust with shims (A) so that clearance (a) is within 0 - 0.2mm (0 - 0.008 in.) at maximum lifting height position.



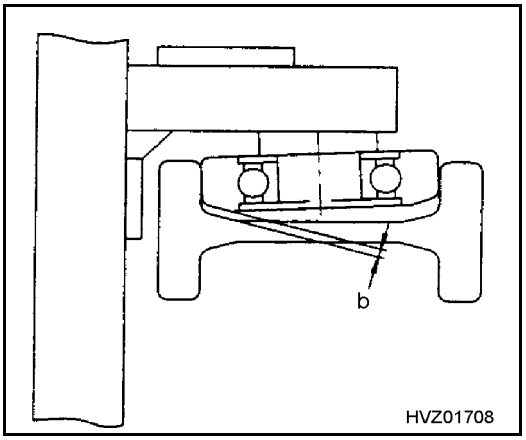
2. Inner main roller
   Adjusting shims
   Adjust with shims (b) so that clearance (b) is within 0 - 0.2mm (0 - 0.008 in.) at maximum lifting height position.



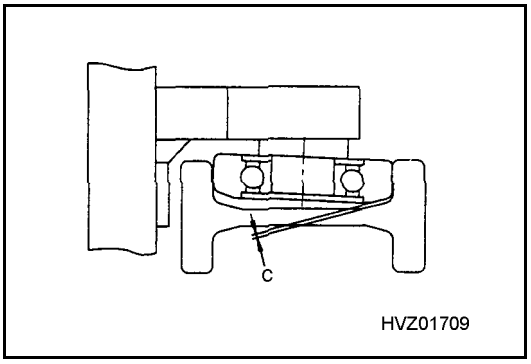
FORK CARRIAGE



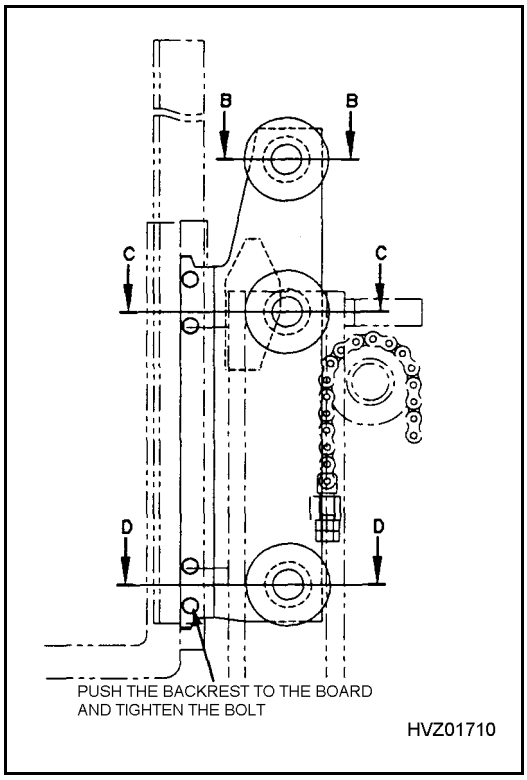
- Insert shims of the same thickness and adjust both sides to obtain:
  $0 \leq a \leq 0.2$mm ($0 \leq a \leq 0.008$ in.)
  (with the fork carriage on top end)



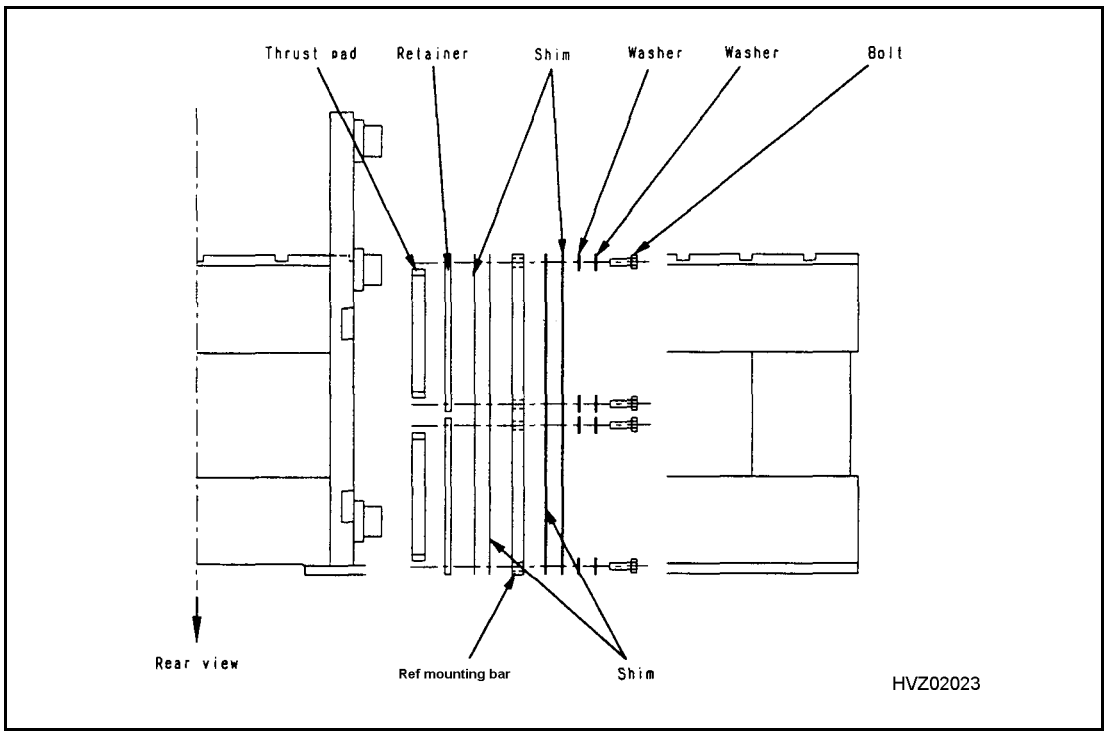
- Insert shims of the same thickness and adjust both sides to obtain:
  $0.2 \leq b \leq 0.2$mm ($0 \leq b \leq 0.016$ in.)
  (with the fork carriage on top end)

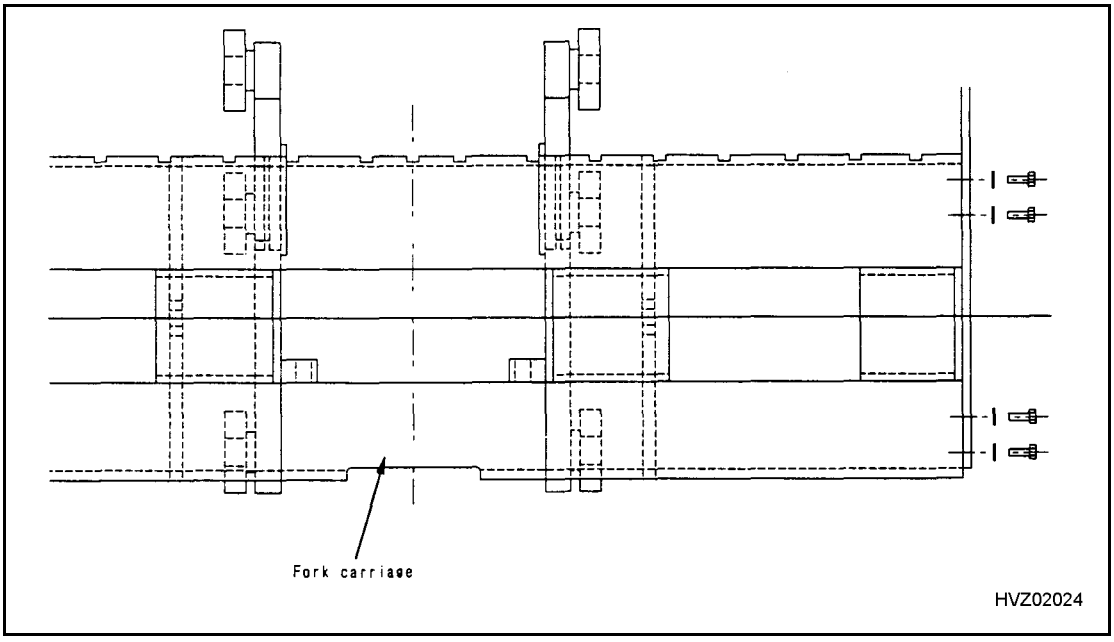


- Insert shims of the same thickness and adjust both sides to obtain:
  $0 \leq c \leq 0.2$mm ($0 \leq c \leq 0.008$ in.)
  (with the fork carriage on top end)



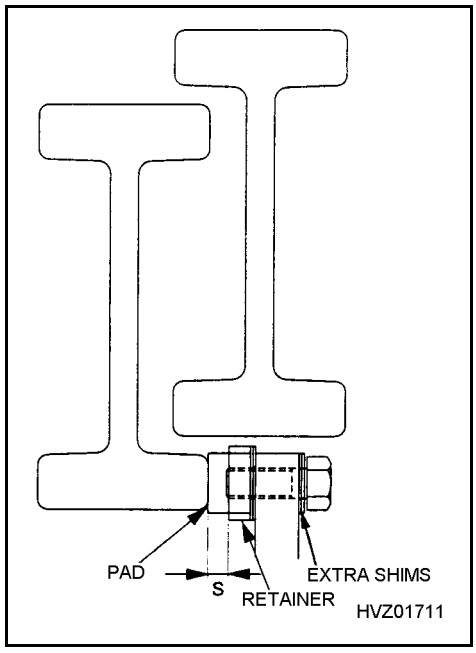
THRUST PAD MOUNTING POSITION





ADJUSTING CLEARANCE THRUST PAD AND RAIL

Re-shim the pads when the clearance becomes 0.08 to 0.08 inches at the widest portion of the inner weldment. This is done by loosening the bolts and moving the required shims to the inside under the thrust pads and retightening the bolts.



Pad changing interval
Change the pad when projection “s” of the pad beyond the retainer decreases to the dimensions displayed below.

Projection “s”	
Standard projection	0.38”
Projection requiring pad change	0.20”

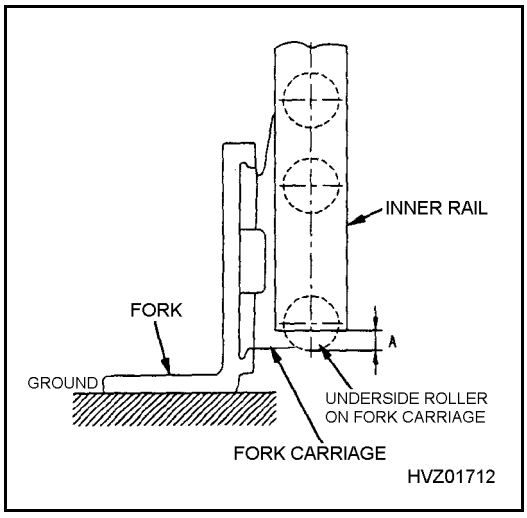
CHECK AND INSPECTION

Check item		Criteria		Remedy
		Standard size (mm)	Repair limit (mm)	
Clearance between inner mast and outer mast	To side	0 - 0.2 (0 - 0.008 in.)	Within 2 (0.08 in.)	Adjust with shims
	To front/rear	0.3 - 1.0 (0.012 - 0.04 in.)	Within 2.5 (0.1 in.)	Replace
Clearance between inner mast and fork carriage	To side	0 - 0.2 (0 - 0.008 in.)	Within 2 (0.08 in.)	Adjust with shims
	To front/rear	0.3 - 1.0 (0.012 - 0.04 in.)	Within 2.5 (0.1 in.)	Replace
	To side roller	0.3 - 0.7 (0.012 - 0.028 in.)	Within 2 (0.08 in.)	Replace
Depth of oil groove in mast support bushing		To be grooved for oil or check if there is an oil groove		Replace
Thickness of fork root	3.5 t	50.8 (2 in.)	Min 42 (1.7 in.)	Replace
	4.0 t		Min 45 (1.8 in.)	
	4.5 t		Min 48 (1.9 in.)	

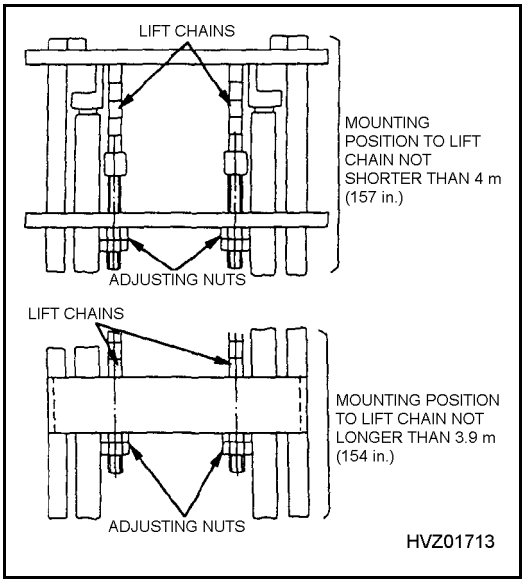
ADJUSTING CLEARANCE BETWEEN INNER MAST AND FORK CARRIAGE

Fit the lift chain on the outer mast and tighten the nut so that the tension on the left and on the right is the same. The protrusion of the main roller from the bottom of the inner mast, with the mast fully lowered, should be equal to protrusion **A**.

Lock nut torque	40 - 60 kgm, 392 - 588 Nm (289 - 434 lbft)

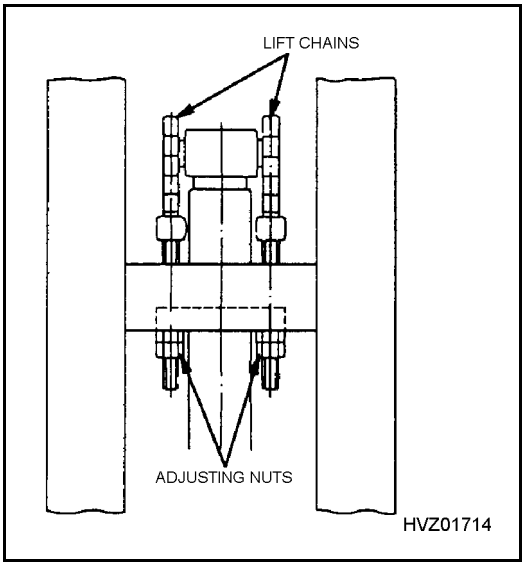


2-Stage Mast



Model	Protrusion A (mm)	
	2-Stage	3-Stage
P80CX G/D	30 (1.18 IN.)	39 (1.53 IN.)
P90CX G/D	35 (1.37 IN.)	39 (1.53 IN.)
C100CX G, P100CX D	35 (1.37 IN.)	44 (1.73 IN.)
C80/100CX	35 (1.37 IN,)	39 (1.53 IN.)

3-Stage Mast

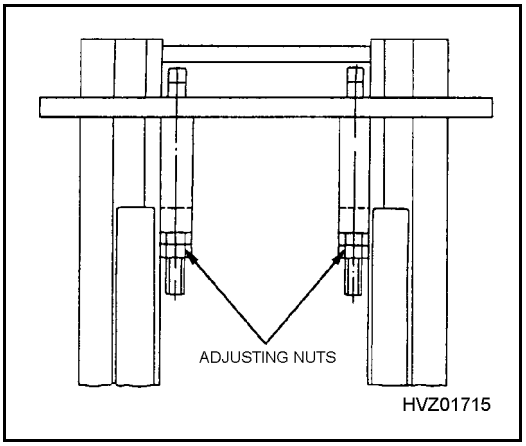


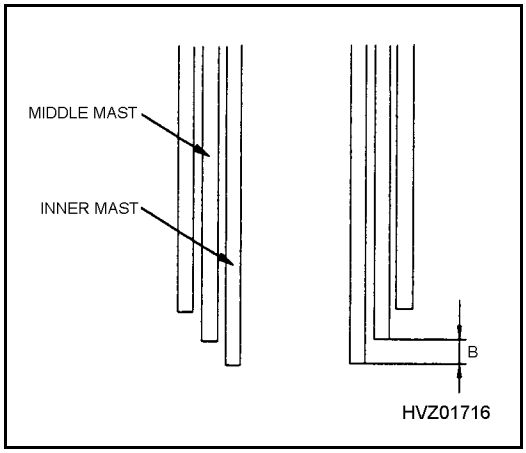
ADJUSTING CLEARANCE BETWEEN INNER MAST AND MIDDLE MAST

3-Stage Mast

Chain stopper adjusting procedure:

Adjust chain so that middle mast and inner mast lower edges (B) are in the same position.





MAST PAIL LUBRICATION

Lubricate the full length of each rail with grease.